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REPORT FOR CONSULTATION ON THE METROPOLITAN OKLAHOMA CITY INTRASTATE AIR QUALITY CONTROL REGION (OKLAHOMA)

National Air Pollution Control Administration
Washington, D. C.

March 1970

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REPORT FOR CONSULTATION ON THE METROPOLITAN OKLAHOMA CITY INTRASTATE AIR QUALITY CONTROL REGION (OKLAHOMA)

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Environmental Health Service

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REPORT FOR CONSULTATION ON THE

METROPOLITAN OKLAHOMA CITY

INTRASTATE AIR QUALITY CONTROL REGION

(OKLAHOMA)

Details of illustrations in
this document may be better
studied on microfiche.

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Environmental Health Service
National Air Pollution Control Administration
March 1970

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PREFACE

The Clean Air Act, as amended, directs the Secretary of Health, Education, and Welfare to designate "air quality control regions" to provide a basis for the adoption of regional air quality standards and the implementation of those standards. The Act stipulates that the designation of a region shall be preceded by consultation with appropriate State and local authorities. This report is intended to provide the basic background information needed for the consultation. It proposes boundaries for the Oklahoma City Intrastate Air Quality Control Region and discusses the factors which are the basis of the proposed boundaries.

The Region* boundaries proposed in this report remain subject to revisions suggested during consultation with State and local authorities. Formal designation of the Region will be made only after a careful review of all opinions and suggestions submitted during the consultation process.

The National Air Pollution Control Administration appreciates assistance received from the State of Oklahoma, the local governments of the area, and the planning agencies in the region.

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*For the purposes of this report, the word "region," when capitalized, will refer to the Oklahoma City Intrastate Air Quality Control Region.

INTRODUCTION

THE REGIONAL APPROACH

Air pollution in the urban areas of the United States is a regional problem which frequently extends across governmental boundaries. Since air pollution problems are rarely confined to any single municipality or county, and are often not confined within a single State, successful control requires coordinated planning, standard setting, and enforcement by the several political jurisdictions which share a common problem. To date, State and local governments across the Nation have only begun to develop a regional approach to air pollution control.

The Clean Air Act, as amended, provides a regional approach which depends upon coordination and cooperation among all levels of government--municipal, county, State, and Federal. To set in motion the machinery for regional air pollution control, the Department of Health, Education, and Welfare designates air quality control regions (following consultation with State and local officials), issues air quality criteria, and publishes reports on control techniques. The designation of region boundaries indicates which State and local jurisdictions will be involved in a regional air pollution control effort. The air quality criteria indicate the extent to which various concentrations of air pollutants are harmful to health and damaging to

property. The reports on control techniques provide information on the costs and effectiveness of various techniques for controlling air pollutant emissions.

After the Department of Health, Education, and Welfare completes these initial steps, State governments develop air quality standards and plans for implementation of such standards within the boundaries of designated air quality control regions. An air quality standard for a region defines the desired limit of concentration of a pollutant in its ambient air. It represents the level of air quality which the regional control program will attempt to achieve. An implementation plan is a blueprint of the steps which will be taken to attain chosen regional air quality standards within a reasonable time. Under the Clean Air Act, State Governors must submit letters indicating that they intend to set air quality standards for those pollutants for which criteria and control technology documents have been issued within 90 days of the designation of air quality control regions by the Secretary of Health, Education, and Welfare. They have an additional 180 days to set the standards. The procedure for setting standards includes a public hearing which allows residents of a region to express their views concerning the proposed standards. The Governors are required to submit to the Secretary, within an additional 180 days, plans for the implementation of the standards which have been adopted.

The Department of Health, Education, and Welfare reviews air quality standards and implementation plans in order to ascertain their consistency with the provisions of the Act.

When air quality standards and implementation plans are approved, States proceed to prevent and control air pollution in accordance with those standards and plans. This system for establishing a regional approach to air pollution control is outlined in Figure 1.

DESIGNATION OF AIR QUALITY CONTROL REGIONS

Designation of an air quality control region is one of the first steps in the regional approach to air pollution control. Section 107 (a) (2) of the Clean Air Act, as amended, directs the Secretary, Department of Health, Education, and Welfare to make such designations. The portions of the section relevant to this discussion state:

> "...The Secretary, after consultation with appropriate State and local authorities shall...designate air quality control regions based on jurisdictional boundaries, urban-industrial concentrations, and other factors including atmospheric areas necessary to provide adequate implementation of air quality standards. The Secretary may... revise the designation of such regions...The Secretary shall immediately notify the Governor or Governors of the affected State or States of such designation."

Procedure for Designation of Regions

Figure 2 illustrates the procedures used by the National Air Pollution Control Administration (NAPCA) for designating air quality control regions.

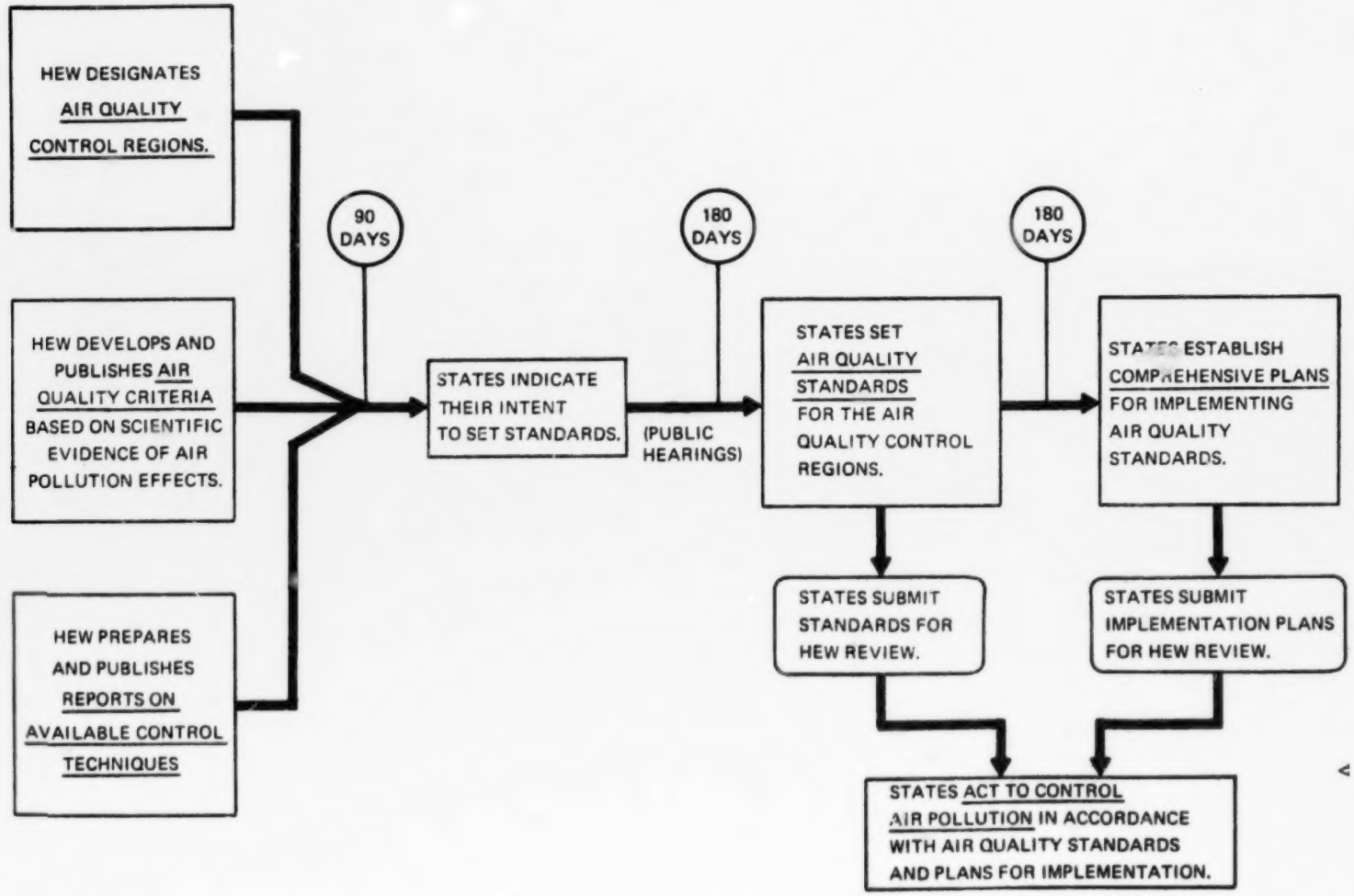
HEW DESIGNATES AIR QUALITY CONTROL REGIONS.
HEW DEVELOPS AND PUBLISHES AIR QUALITY CRITERIA BASED ON SCIENTIFIC EVIDENCE OF AIR POLLUTION EFFECTS.
HEW PREPARES AND PUBLISHES REPORTS ON AVAILABLE CONTROL TECHNIQUES
90 DAYS
STATES INDICATE THEIR INTENT TO SET STANDARDS.
180 DAYS
(PUBLIC HEARINGS)
STATES SET AIR QUALITY STANDARDS FOR THE AIR QUALITY CONTROL REGIONS.
180 DAYS
STATES ESTABLISH COMPREHENSIVE PLANS FOR IMPLEMENTING AIR QUALITY STANDARDS.
STATES SUBMIT STANDARDS FOR HEW REVIEW.
STATES SUBMIT IMPLEMENTATION PLANS FOR HEW REVIEW.
STATES ACT TO CONTROL AIR POLLUTION IN ACCORDANCE WITH AIR QUALITY STANDARDS AND PLANS FOR IMPLEMENTATION.

FIGURE 1 - Flow Diagram for Action to Control Air Pollution on a Regional Basis, Under the Clean Air Act

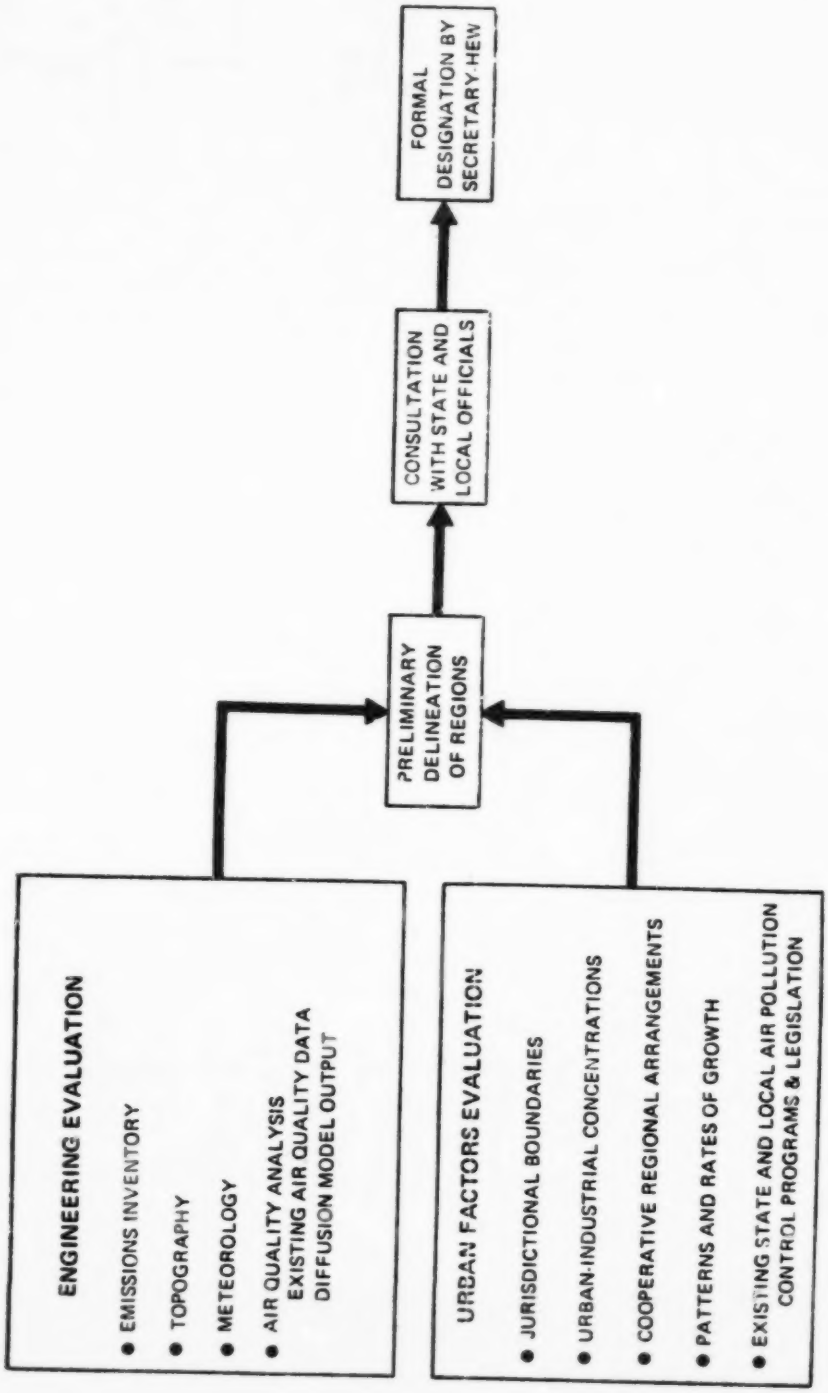
ENGINEERING EVALUATION
• EMISSIONS INVENTORY
• TOPOGRAPHY
• METEOROLOGY
• AIR QUALITY ANALYSIS
EXISTING AIR QUALITY DATA
DIFFUSION MODEL OUTPUT
URBAN FACTORS EVALUATION
• JURISDICTIONAL BOUNDARIES
• URBAN-INDUSTRIAL CONCENTRATIONS
• COOPERATIVE REGIONAL ARRANGEMENTS
• PATTERNS AND RATES OF GROWTH
• EXISTING STATE AND LOCAL AIR POLLUTION CONTROL PROGRAMS & LEGISLATION
PRELIMINARY DELINEATION OF REGIONS
CONSULTATION WITH STATE AND LOCAL OFFICIALS
FORMAL DESIGNATION BY SECRETARY HEW

FIGURE 2 - Flow Diagram for the Designation of Air Quality Control Regions

After evaluating relevant technical and urban factors in a region, the National Air Pollution Control Administration publishes a proposed delineation of its boundaries. At the same time, NAPCA sets a time and place for a consultation meeting and distributes to State and local authorities a report of the evaluation study (such as this "Report for Consultation") which includes the boundary proposal. At the consultation meeting State and local authorities are encouraged to present fully their views and suggestions concerning the proposed boundaries of the region. Interested parties who do not have official status may submit comments in written form for the record. After careful review of all suggestions and opinions submitted for the record by interested parties, the Secretary of Health, Education, and Welfare makes a formal designation of the region boundaries and notifies the Governor(s) of the State(s) affected by the designation.

The Size of a Region

As stipulated in Section 107 (a) (2), the designation of air quality control regions should be based on "jurisdictional boundaries, urban-industrial concentrations, and other factors including atmospheric areas necessary to provide adequate implementation of air quality standards." This language suggests a number of objectives which are important in determining how

large an air quality control region should be. Basically, these objectives can be divided into three separate categories.

First, a region should be self-contained with respect to air pollution sources and receptors. Unfortunately, since air pollutants can travel long distances, it is impractical if not impossible to delineate regions which are completely self-contained. The air over a region will usually have at least trace amounts of pollutants from external sources. During episodic conditions, such contributions from external sources may even reach significant levels. Conversely, air pollution generated within a region and transported out of it can affect external receptors to some degree. It would be impractical and inefficient to make all air quality control regions large enough to encompass these low-level trace effects. The geographic extent of trace effects overestimates the true problem area which should be the focus of air pollution control efforts. Thus, the first objective, that a region be self-contained, becomes a question of relative magnitude and frequency. The dividing line between "important influence" and "trace effect" will be a matter of judgment. The judgment should be based on estimates of the impact a source has upon a region, and the level of pollution to which receptors are subjected. In this respect, annual and seasonal data on pollutant emissions and ambient air concentrations are a better measure of relative influence than short term data on episodic conditions. In summary, a region

should include most of the important sources in the area as well as most of the people and property affected by those sources. In this way, all the major elements of the regional problem will lie within one unified administrative jurisdiction.

The second general objective requires that regional boundaries be designed to meet not only present conditions but also future conditions. In other words, the region should include areas where industrial and residential expansion are likely to create air pollution problems in the foreseeable future. This objective requires careful consideration of existing metropolitan development plans, expected population growth, and projected industrial expansion. Such considerations should result in the designation of regions which will contain the sources and receptors of regional air pollution for a number of years to come. Of course, regional boundaries need not be permanently fixed, once designated. Boundaries should be reviewed periodically and altered when changing conditions warrant readjustment.

The third objective is that regional boundaries should be compatible with and even foster unified and cooperative governmental administration of the air resource throughout the region. Because air pollution usually extends across governmental boundaries, the cooperation of several governmental bodies is required for the solution of a common set of air pollution problems. In this regard, the established patterns of governmental cooperation

on a range of urban problems is an important consideration, and the pattern of cooperation among existing air pollution control programs is a particularly relevant factor. In general, administrative considerations would argue against the division of governmental jurisdictions. Although it would be impractical to preserve State jurisdictions undivided, usually it is possible to preserve the unity of county governments by including or excluding them in their entirety. Occasionally, even this would be impractical due to a county's large size, wide variation in level of development, or striking topographical features.

To the extent that any two of the above three objectives lead to incompatible conclusions concerning region boundaries, the region must represent a reasonable compromise. A region should represent the best way of satisfying the three objectives simultaneously.

As noted above, the evaluations of relevant technical factors and urban factors form the basis of the boundary proposals published by NAPCA. The technical factors study takes account of the location of pollution sources and the geographic extent of serious pollutant concentrations in the ambient air. Pollution sources are identified through an inventory of emissions from power generation, industrial operations, space heating, waste disposal, and other pollution-causing activities. The transport and distribution of pollutants in the ambient air are analyzed on the basis of measured air quality data, the location of emissions,

meteorological data, and topographic information. A mathematical diffusion model which predicts ambient pollution concentrations from information on emissions and meteorology can be used in areas where irregular topographical features would not invalidate the theoretical model. As a whole, the technical factors study indicates how large the air quality control region should be in order to encompass most pollution sources and most people and property affected by those sources.

The study of urban factors takes account of a different set of considerations. It discusses the location of urban and industrial concentrations, expected patterns of urban growth, governmental jurisdictions in regions, cooperative regional arrangements, existing State and local air pollution control programs, and other such factors. As a whole, the urban factors study indicates how large a region should be in order to encompass expected regional growth and to encourage cooperation among political units in controlling air pollution.

The body of this report contains a proposal for the boundaries of the Oklahoma City Intrastate Air Quality Control Region, following evaluation of technical and urban factors. The report is intended to serve as the background document for the formal Consultation between the National Air Pollution Control Administration and the appropriate State and local authorities.

EVALUATION OF URBAN FACTORS

The factors of major importance in considering boundaries for an air quality control region are those which have to do with the size, shape, nature, and dynamics of urbanization within the region. In this discussion of the Oklahoma City area, the geography of the region is reviewed initially since its location and physical characteristics can affect both the scale and direction of its urban growth. The area's present and projected population and economic activity patterns are then considered. Future growth and its implications for the physical configuration of the Oklahoma City urban area are of particular importance in determining the size of the Region.

GEOGRAPHY OF THE REGION

The Oklahoma City area is defined for study purposes as the Oklahoma City Standard Metropolitan Statistical Area counties--Canadian, Oklahoma, and Cleveland--and adjacent counties--Kingfisher, Logan, and Lincoln to the north and Grady, McClain, and Pottawatomie Counties to the south.

The area is in the geographic center of the State of Oklahoma. Its land surface is typified by gently rolling prairie and low-lying hills. The terrain slopes generally eastward and ranges from about 1,600 feet above sea level at points in western Kingfisher County to around 1,100 feet in eastern Pottawatomie County. Running southeastward through the area are the drainage basins of the Cimmaron, Deep Ford, North Canadian, and South Canadian Rivers.

Before Oklahoma was opened to white settlement, the Oklahoma City area became known since it was located on the direct path of cattle trails running northward from Texas to Kansas. The Chisholm Trail, for example, passed through present-day Canadian County. By the time the first settlement "run" was permitted, the cattle drives had ceased since the Santa Fe Railroad had extended its lines from Kansas to what is now Oklahoma City and the Rock Island Railroad had nearly completed a similar line into El Reno in Canadian County. These transportation links added to the lure of good agricultural land in the region for would-be settlers. As a result, the first settlement run created instant towns as an estimated 50,000 people rushed into the Oklahoma City area to stake out homesteads.

Thereafter, cattle production as well as agriculture thrived. By 1907, when Oklahoma was admitted into the Union, the three-county area of Canadian, Oklahoma, and Cleveland Counties had a population approaching 100,000. Two large meat packing plants were established in Oklahoma City in that period. These plants were forerunners of food processing industries which are still of significance in the area.

An economy dominated by agriculture continued until 1928 when an immensely rich oil field was discovered in Oklahoma City. Oil wells proliferated, and another population boom started. Between 1920 and 1930, the population of Canadian, Oklahoma, and Cleveland Counties rose from about 155,000 to nearly 275,000.

Apart from being located on top of one of the world's great oil pools, the Oklahoma City area also lies in the heart of one of the Nation's most productive natural gas fields. After World War II, when the advantages of natural gas for space heating, power generation, and more recently, as raw material for the chemicals industries--were realized--natural gas production in the area soared. Both oil and natural gas continue to be major sources of income in the area. In 1967, the Bureau of Mines reported that the gross value of natural gas and crude oil production in the State as a whole increased to more than four times the value produced in 1945.[1] The counties in the Oklahoma City study area have shared significantly in this increased level of output.

The Oklahoma City area was chosen during World War II for a military aircraft maintenance base and supply depot and for ground and air training of Army Air Corps personnel. Although the composition of activities undertaken has changed, the Federal Government still maintains important military and civil aircraft service centers in the area. These centers have in turn encouraged growth of support industries in the private sector.

Each of these successive major stimulants to the growth of the Oklahoma City area is inseparable from the geographic and resource characteristics of the area. Yet none could have been as stimulating without coincident national and international demands. Thus, the area has been and is still "export industry" oriented to an unusual degree for an inland region.

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[1] U. S. Department of the Interior, Bureau of Mines, 1967 Minerals Yearbook, Vol. III, Area Reports: Domestic.

PRESENT POPULATION AND ECONOMIC ACTIVITY PATTERN OF REGION

The most recent estimates of population in the Oklahoma City area are those of the Oklahoma Employment Security Commission (OESC). These estimates, as shown in Table I, are for July 1968. The estimated 1968 population of the Oklahoma City SMSA counties (Canadian, Cleveland, and Oklahoma) was 601,600. The six adjacent counties (Grady, Kingfisher, Lincoln, Logan, McClain, and Pottawatomie) were estimated to contain 135,600 persons. Considered in relation to total county land area, population densities are moderate in Oklahoma and Cleveland Counties and low to very low in all the others (Figure 3).

From the population densities shown in Figure 3 it is not possible to determine the exact locations and extent of urban and non-urban development. As is often true in many Central and Western states, the counties in the study area are quite large, and density averages computed for such counties can as often conceal as reveal the intensity of urbanization.

Statistics on the proportion of land area classified as farms are not always helpful in distinguishing "urban" from "non-urban" areas. A very high share of the total land area of the Oklahoma City area counties was classified as farmland in the 1964 agricultural census--the percentages range from a low of 52.2 percent in Oklahoma County to 99.9 percent in Kingfisher. Yet the employed work force in these counties is overwhelmingly engaged in nonfarm occupations, and could therefore be tied to the urban center of Oklahoma City (Table II).

Table I

Estimated Population of Oklahoma City Area Counties, 1968

Counties	Total (thousands)
Oklahoma City SMSA Counties, Total	(601.6)
Canadian	31.5
Cleveland	76.1
Oklahoma	494.0
Adjoining Counties, Total	(135.6)
Grady	30.1
Kingfisher	12.6
Lincoln	19.5
Logan	18.1
McClain	13.4
Pottawatomie	41.9

Source: Oklahoma Employment Security Commission, Research and Planning Division, Oklahoma Population Estimates, July 1968 Data.

Note: SMSA refers to "Standard Metropolitan Statistical Area," established by the U. S. Bureau of the Census.

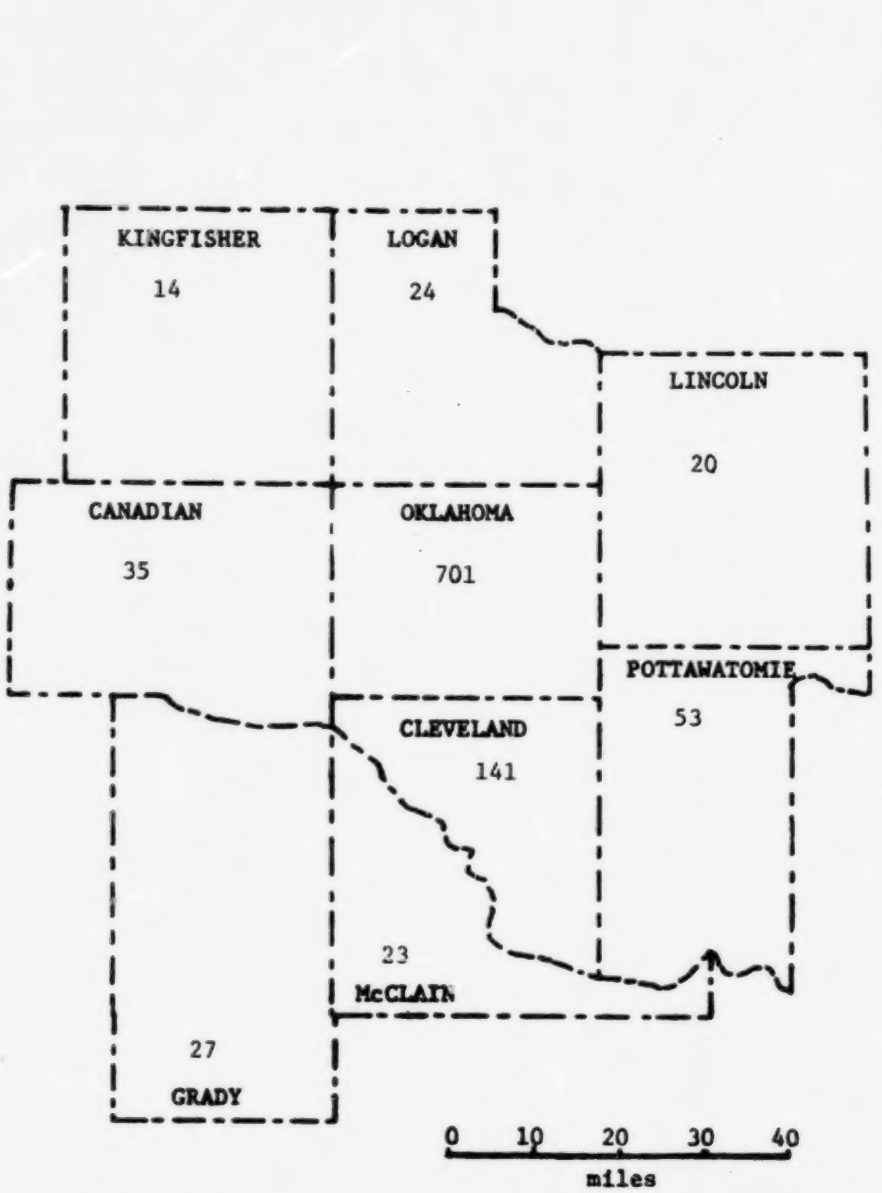

FIGURE 3 - Population Per Square Mile of Oklahoma City Area Counties, 1968

Source: Based on population estimates by Oklahoma Employment Security Commission.

Table II

Total Land Area, Percent of Area in Farms, and Percent, Nonfarm Employment, Oklahoma City Area Counties

Counties	Total Land Area (Sq. Mi.)	Percent, Area in Farms, 1964	Percent, Nonfarm Employment, 1969
Oklahoma City SMSA Counties			
Canadian	897	94.6)	
Cleveland	541	60.3)	98.1
Oklahoma	705	52.2)	
Adjacent Counties			
Grady	1,096	92.5	75.2
Kingfisher	904	99.9	56.9
Lincoln	973	79.7	71.8
Logan	751	84.5	72.0
McClain	573	89.3	67.7
Pottawatomie	794	79.5	83.6

Sources: Land area data from U.S. Department of Commerce, Bureau of the Census, County and City Data Book, 1967; nonfarm employment ratios calculated from data in Oklahoma Employment Security Commission, Oklahoma Labor Force Estimates, June 1967-1969.

A better idea of the size of the Oklahoma City urban area can be obtained by examining Figure 4, which is based on a map prepared by the Association of Central Oklahoma Governments (ACOG). Figure 4 reveals that the urban area of the three-county SMSA region is at present contained within the region's borders and that underdeveloped areas are available for future expansion. However, the Oklahoma City Area Regional Transportation Study (OCARTS) suggests that considerable commuting occurs daily from areas outside the three-county SMSA. The effect of this additional daily traffic on main arteries leading to the center of the City is shown in Figure 5. The traffic inflow means that urbanization pushing outward from Oklahoma City has either "leapfrogged" over available undeveloped space, or that established population clusters and cities such as Guthrie in Logan County, Shawnee in Pottawatomie County, and smaller towns in McClain County, are becoming suburbs of Oklahoma City. These "push" and "pull" forces may also be operating together. The urban area defined to include such population clusters would, of course, be different from that shown in Figure 4.

The present economic activity pattern of the nine-county area, in terms of employment, is shown in Table III. It is clear that the bulk of non-agricultural employment is concentrated in the three-county Oklahoma City SMSA. The striking feature of the metropolitan area's employment profile (Figure 6) is the high proportion (25.1 percent) of total employment accounted for by government and the relatively small share contributed by manufacturing

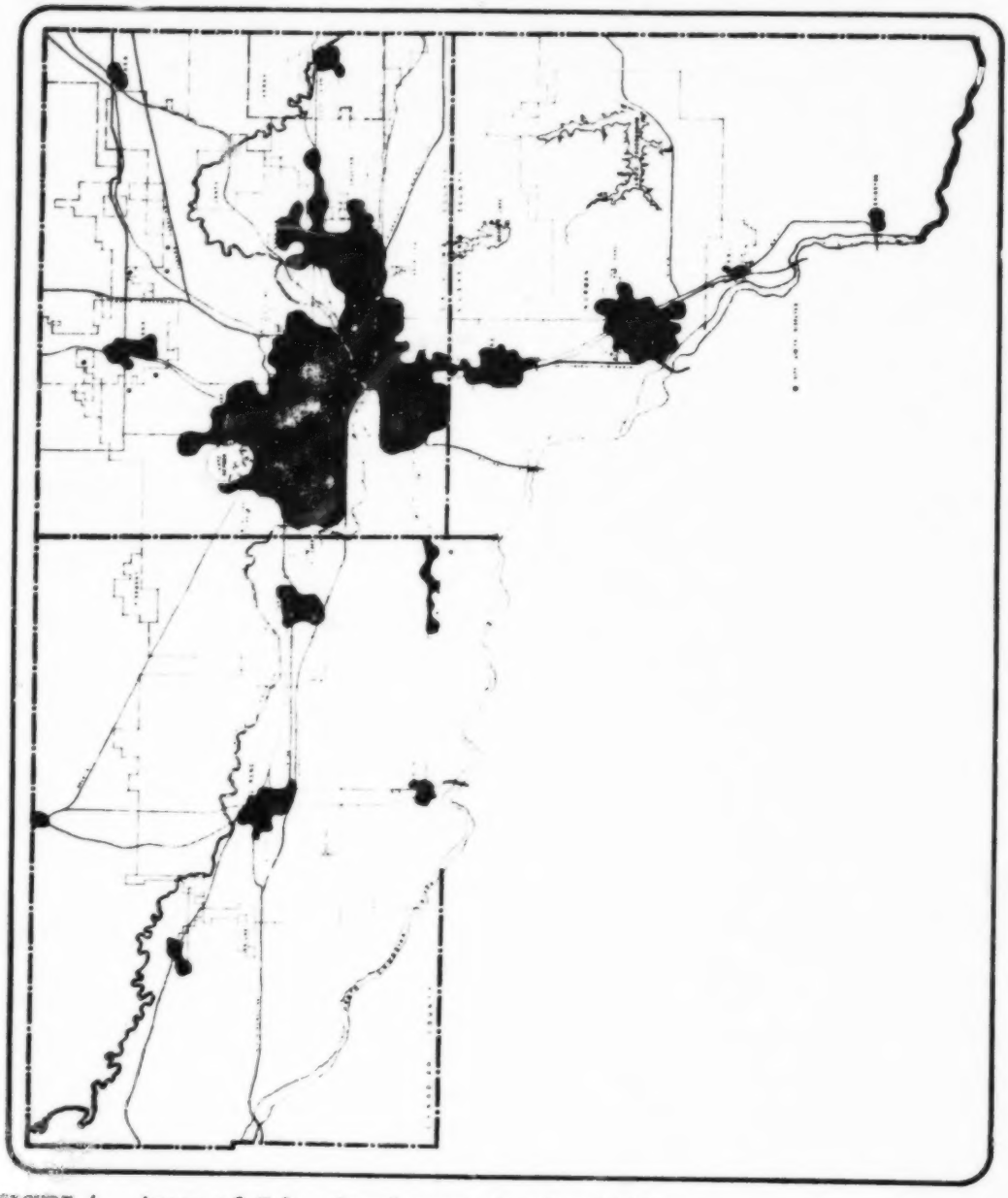

FIGURE 4 - Areas of Urban Development in the Oklahoma City SMSA Counties, 1968

Source: Based on a map published by the Association of Central Oklahoma Governments.

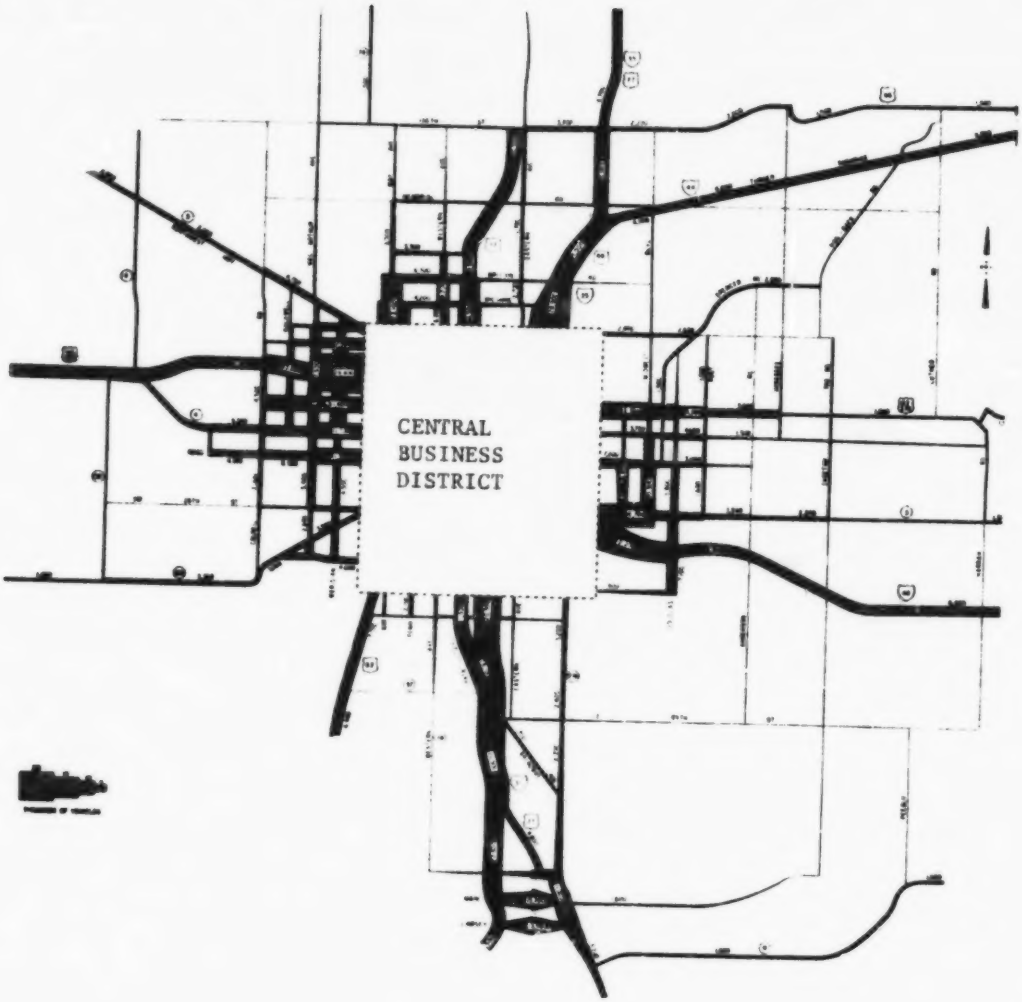

FIGURE 5 - Average Daily Traffic Flow,
OKLAHOMA CITY AREA, 1965.

Source: Oklahoma City Area Regional Transportation Study.

Table III

Employment in Oklahoma City Area Counties, June 1969

(Number of Employees)

	Oklahoma City SMSA Counties	Grady	King fisher	Lincoln	Logan	McClain	Potta-watomie
Total Employment	280,200	8,950	5,610	4,960	5,570	3,280	10,975
Agriculture	5,200	2,220	2,420	1,400	1,560	1,060	1,800
Domestic Service, Self-employed, Unpaid Family Workers	27,500	930	610	600	480	470	1,500
Manufacturing	34,900	1,290	110	500	*	150	1,000
Wholesale and Retail Trade	53,900	1,360	610	820	800	470	2,125
Government	70,400	1,440	490	660	940	560	1,525
All Other	88,300	1,710	1,370	980	1,790	570	3,025

Source: Oklahoma Employment Security Commission, Oklahoma Labor Force Estimates, June 1967-1969.

* Data withheld to avoid disclosure of information on specific firms. Manufacturing employment included in "All Other."

	Percent of Total
Agriculture	1.9
Domestic service, self-employed, unpaid family workers	9.8
Manufacturing	12.5
Wholesale and retail trade	19.2
Government	25.1
All other, including mining	31.5

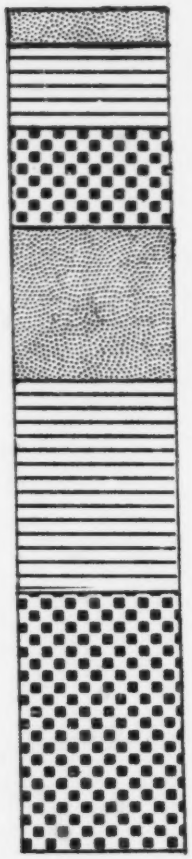

FIGURE 6 - Distribution of Oklahoma City SMSA Employment, June 1969

Source of data: Oklahoma Employment Security Commission, Oklahoma Labor Force Estimates, June 1967-69.

(12.5 percent). This relationship appears also in the analysis of sources of personal income in Table IV. Table IV shows, however, that between 1959 and 1967 both government and manufacturing gained primarily at the expense of mining, contract construction, and trade.

Manufacturing in the three-county SMSA area, accounting for employment of 34,900 persons, is broadly diversified. It ranges from industries based on local resources or local needs--such as flour milling, meat packing, gas processing, crude oil production, structural steel fabrication, and oil field equipment manufacture--to others such as the production of aircraft, truck trailers, telephones and telephone exchange equipment, and computers.

Government employment in the area totaling 70,400 includes employment of some 30,000 persons by the Federal Government military aircraft facility at Tinker Air Force Base. Although this facility is not classified as a manufacturing plant, it engages in many industrial-type operations during the major overhaul of aircraft and jet engines. These operations include electroplating, heat treating of metal, painting, solvent cleaning of engine parts, sandblasting, and the testing of jet engines.

PROSPECTIVE POPULATION AND ECONOMIC GROWTH

The Oklahoma Employment Security Commission (OESC) estimates that in the six-year period, 1960-66, the Oklahoma City SMSA population increased from a Census figure of 511,833 to 587,000.

Table IV

Sources of Personal Income in the Oklahoma City Metropolitan Area,* 1959 and 1967

(Percent of total personal income)

	1959	1967
Total Personal Income	100.0	100.0
Property Income and Transfer Payments, Less Personal Contributions for Social Insurance	17.3	17.1
Total Earnings	82.7	82.9
Farm Earnings	.8	.9
Total Nonfarm Earnings	81.9	82.0
Government Earnings	20.5	22.9
Total Federal	14.5	16.1
Federal Civilian	12.5	13.8
Military	2.0	2.3
State and Local	6.0	6.8
Private Nonfarm Earnings	61.4	59.1
Manufacturing	8.8	11.9
Mining	4.6	3.4
Contract Construction	6.1	4.5
Transportation, Communication and Public Utilities	7.2	6.6
Wholesale and Retail Trade	17.9	15.4
Finance, Insurance, and Real Estate	5.8	5.8
Services	10.9	11.4
Other	0.1	0.1

Source: Unpublished analysis obtained from the U.S. Department of Commerce.

* Canadian, Cleveland, and Oklahoma Counties

The average annual growth rate indicated by the OESC is, therefore, 2.2 percent. However, the OESC population estimate of 601,600 for 1968 indicates a recent moderation in growth to an annual rate of around 1.5 percent.

For the years ahead, there is a considerable divergence in estimates of probable population growth for the SMSA counties. The National Planning Association of Washington, D. C. (NPA) estimates an annual growth rate for the period 1966-80 of 2.1 percent.[2] The Bureau of the Census, on the other hand, has suggested for the years 1965-75, lower alternate annual growth rates of 1.8 and 1.4 percent.[3]

Based on the estimated OESC population of 601,600 for 1968, and at annual growth rates of 1.4 percent (Census), 1.5 percent (OESC estimate for 1966-68), 1.8 percent (Census), and 2.1 percent (NPA), 1985 population for the SMSA counties would be 762,000; 775,000; 815,000; or 857,000, respectively. The OCARTS transportation study and an OCOG study of water and sewer needs use a still higher 1985 population estimate of 987,000. The five estimates yield percentage increases in population between 1968 and 1985 of as little as 27 percent and as high as 64 percent. Whether actual growth in the 15 years ahead will

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[2] National Planning Association, Economic and Demographic Projections for States and Metropolitan Areas, Regional Economic Projections Series, Report No. 68-R-1, January 1969.

[3] U. S. Department of Commerce, Bureau of the Census, Projections of the Population of Metropolitan Areas - 1975 Series P-25, No. 415, January 31, 1969.

approximate the lower or the higher estimated figures depends in large part on the area's economic growth, since in-migration responding to the pull of job opportunities accounts for a major share of population increases in the most rapidly growing urban areas.

Recent economic expansion in the Oklahoma City SMSA area has been at a rate substantially above that for all metropolitan areas in the United States. The U. S. Department of Commerce estimates that in the period 1959-67, total personal income increased 72 percent in the Oklahoma City SMSA area compared to an average increase of 63 percent in all metropolitan areas (Table V). This growth has been due largely to increased diversity and higher volume of manufacturing activity. Economic growth has also been given increased impetus by additions to Federal Government payrolls in the City.

For the future, the area's recently demonstrated capacity to shift its earnings base markedly toward manufacturing the more rapidly expanding industries argues for continued strong growth. There are, for example, indications that the natural gas resources of the area may for the first time be exploited locally for use as raw materials in chemicals and chemical products manufacture. The employment effects of highly capitalized industries such as this will not be as significant for production workers as for white collar employees. This is true, for example, of the area's oil and natural gas production industries in which 60 percent of the personnel classified as mining employees are actually head office administration and

Table V

Growth in Personal Income and Per Capita Personal Income, Oklahoma City Metropolitan Area,* and all Metropolitan Areas of the United States, 1959-67

	Personal Income			Per Capita Personal Income		
	1959 (millions of dollars)	1967 (millions of dollars)	Percent Increase, 1959-67	1959 (dollars)	1967 (dollars)	Percent Increase, 1959-67
Oklahoma City, Metropolitan Area*	1,064	1,831	72.1	2,092	3,028	44.7
All Metropolitan Areas	290,062	473,246	63.2	2,448	3,511	43.4

Source: U.S. Department of Commerce, "Metropolitan Area Income in 1967," Survey of Current Business, May, 1969, Part I, pp. 13 - 33.

* Canadian, Cleveland, and Oklahoma Counties.

clerical staff. A negative factor regarding continued growth, however, is the vulnerability of the defense-related portion of present Federal Government employment.

With industrial growth, steady additions to electric power capacity will be required. At present, the power generation plants in the Oklahoma City area are able to burn natural gas and to do so economically because of the plentiful local supply. However, Oklahoma utility companies are planning for the construction of coal burning plants for future power production. One non-nuclear 1,325 megawatt unit is planned in Logan County by the Oklahoma Gas and Electric Company for 1980.[4]

PROBABLE DIRECTIONS OF PHYSICAL GROWTH

The population projections discussed above for the Oklahoma City SMSA will require development accommodating the residential, commercial, and occupational needs of a minimum of 27 percent to a maximum of 64 percent more people by the ACOG target planning year of 1985.

Assuming that the region's population will have increased to 987,000 in 1985 and to approximately one million in 1990, ACOG has advised its member governments that future growth could be guided by a radial corridors plan (Figure 7), by a satellite cities plan (Figure 8), or by the present trend towards "urban sprawl" (Figure 9).

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[4] South Central Regional Advisory Committee, Electric Power in the South Central Region, 1970, 1980, 1990, A Report to the Federal Power Commission, February 1969.

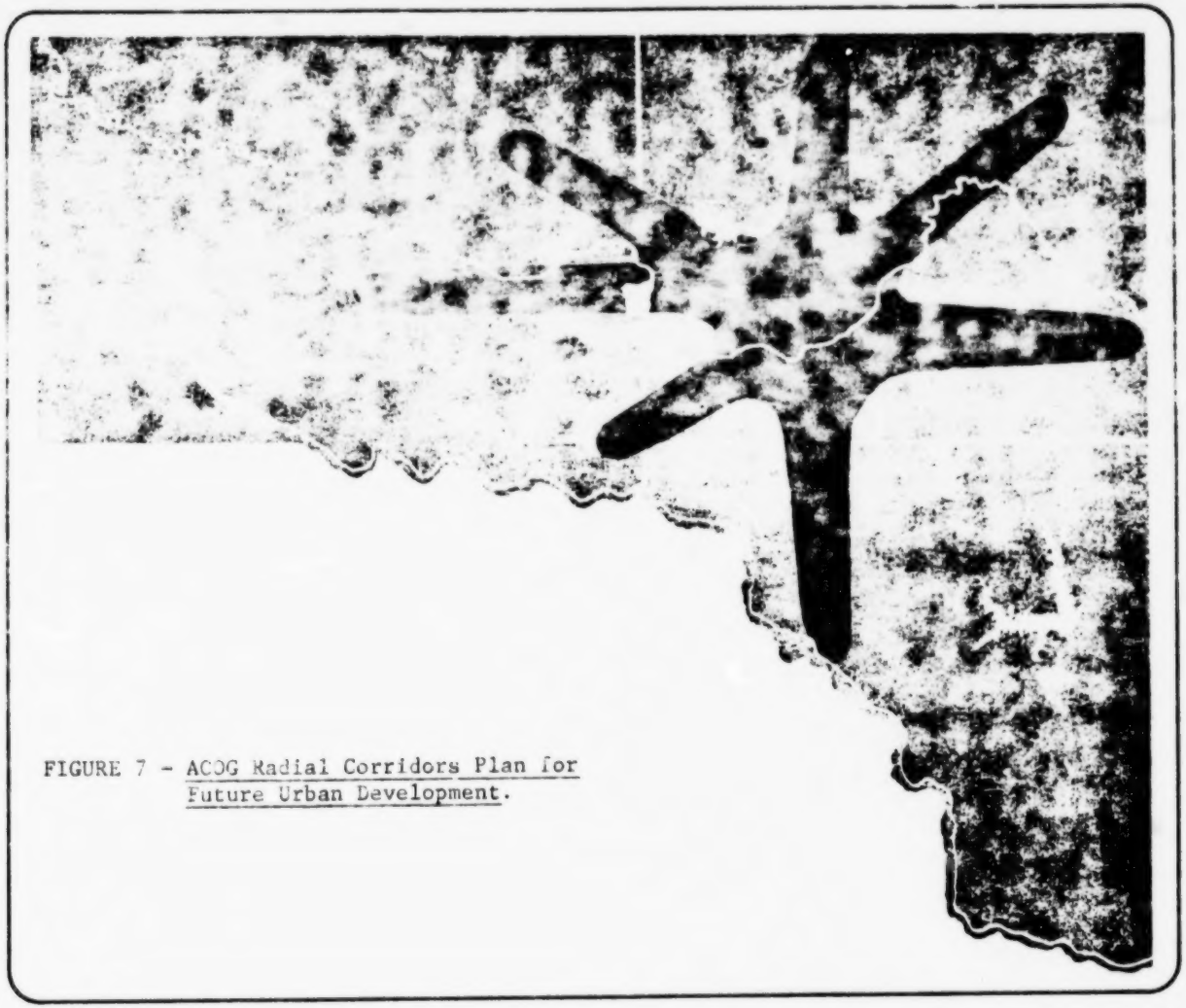

FIGURE 7 - ACOG Radial Corridors Plan for Future Urban Development.

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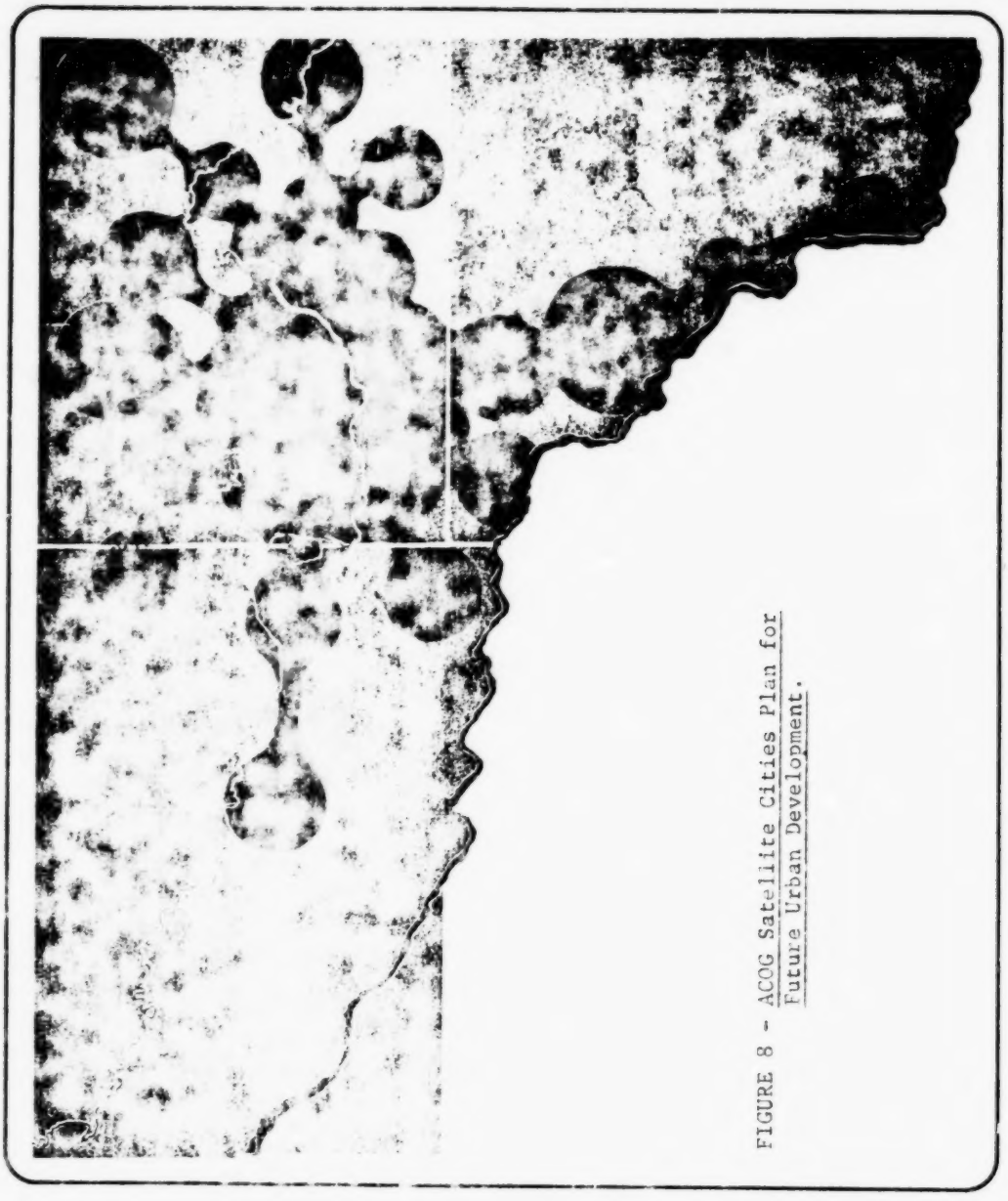

FIGURE 8 - ACOG Satellite Cities Plan for Future Urban Development.

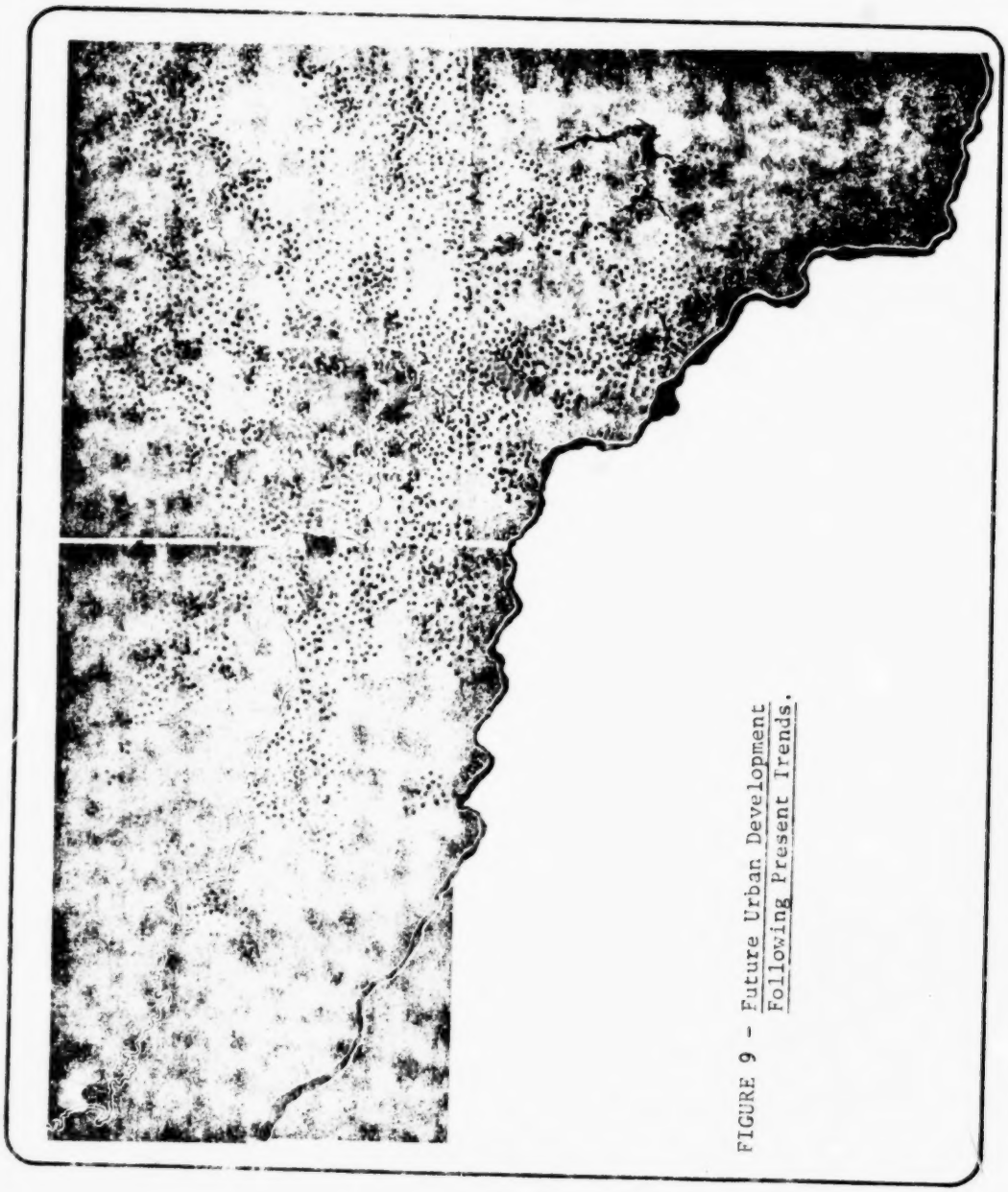

FIGURE 9 - Future Urban Development Following Present Trends.

The Oklahoma City Department of Planning has made a 1989 physical development forecast covering nine counties surrounding the City because they "are within the direct economic sphere of influence of Oklahoma City," and "as the metropolitan area grows, Oklahoma City and the surrounding cities will become an interdependent, urbanized area."[5] The Department's forecast of future urban growth, therefore, includes development of the non-SMSA cities of Kingfisher, Chickasha, Shawnee, and Guthrie as well as of cities within the SMSA (Figure 10).

The highway network in the Oklahoma City area (Figure 11) is consistent with any of the three possible alternative patterns of future urban growth. Because of the high commutation which occurs across the SMSA boundaries, however, growing interdependence of Oklahoma City with counties adjacent to the SMSA is more likely than the various ACOG alternatives which suggest confinement of urban growth within the SMSA.

In this connection, it should be noted that freeways extend North-South, East-West, and Southwest-Northeast through Oklahoma City. The Southwest-Northeast freeway is a toll road, however, which has few access points in Grady and Lincoln Counties. Thus, continuous development toward Grady and Lincoln Counties is less likely than in the other directions unless additional interchanges are provided. Development beyond the western boundary

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[5] Oklahoma City Department of Planning, 1989 Central Oklahoma Sketch Plan, November 1967.

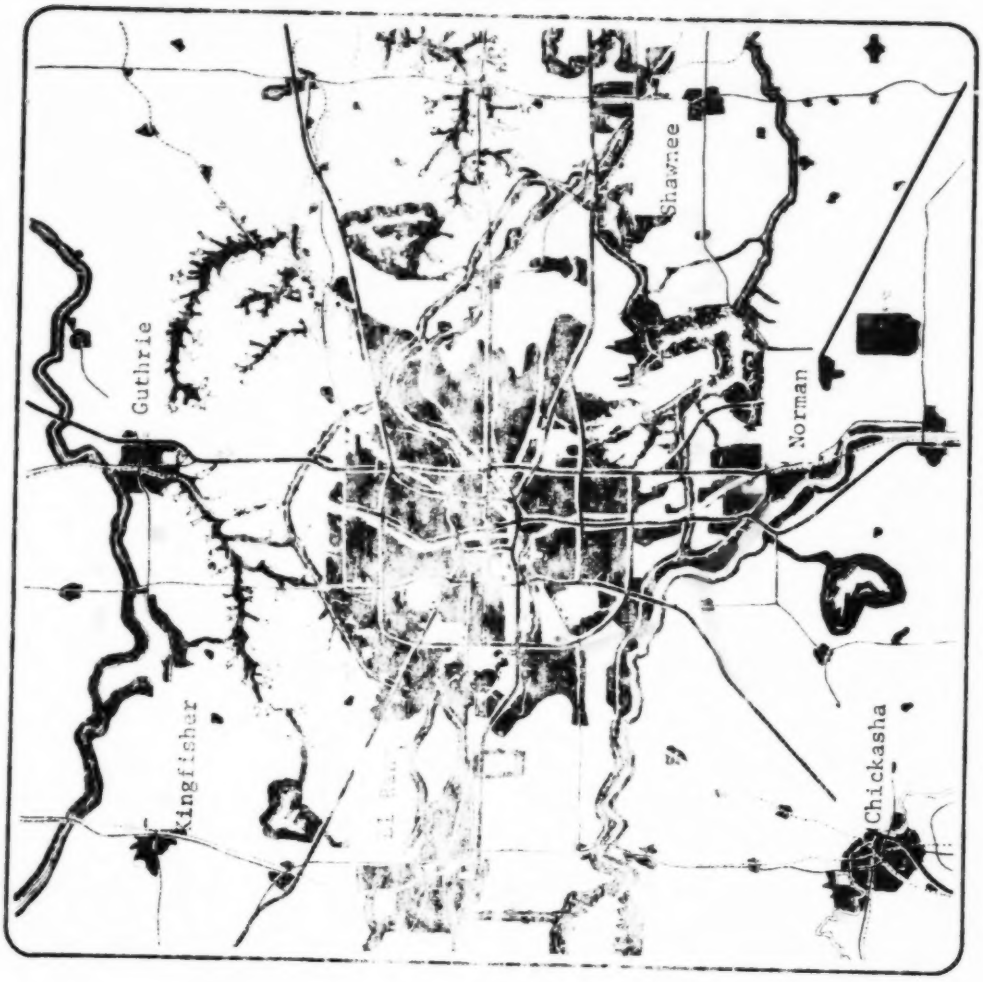

FIGURE 10 - Oklahoma City Department of Planning Forecast of Urban Physical Development in 1989.

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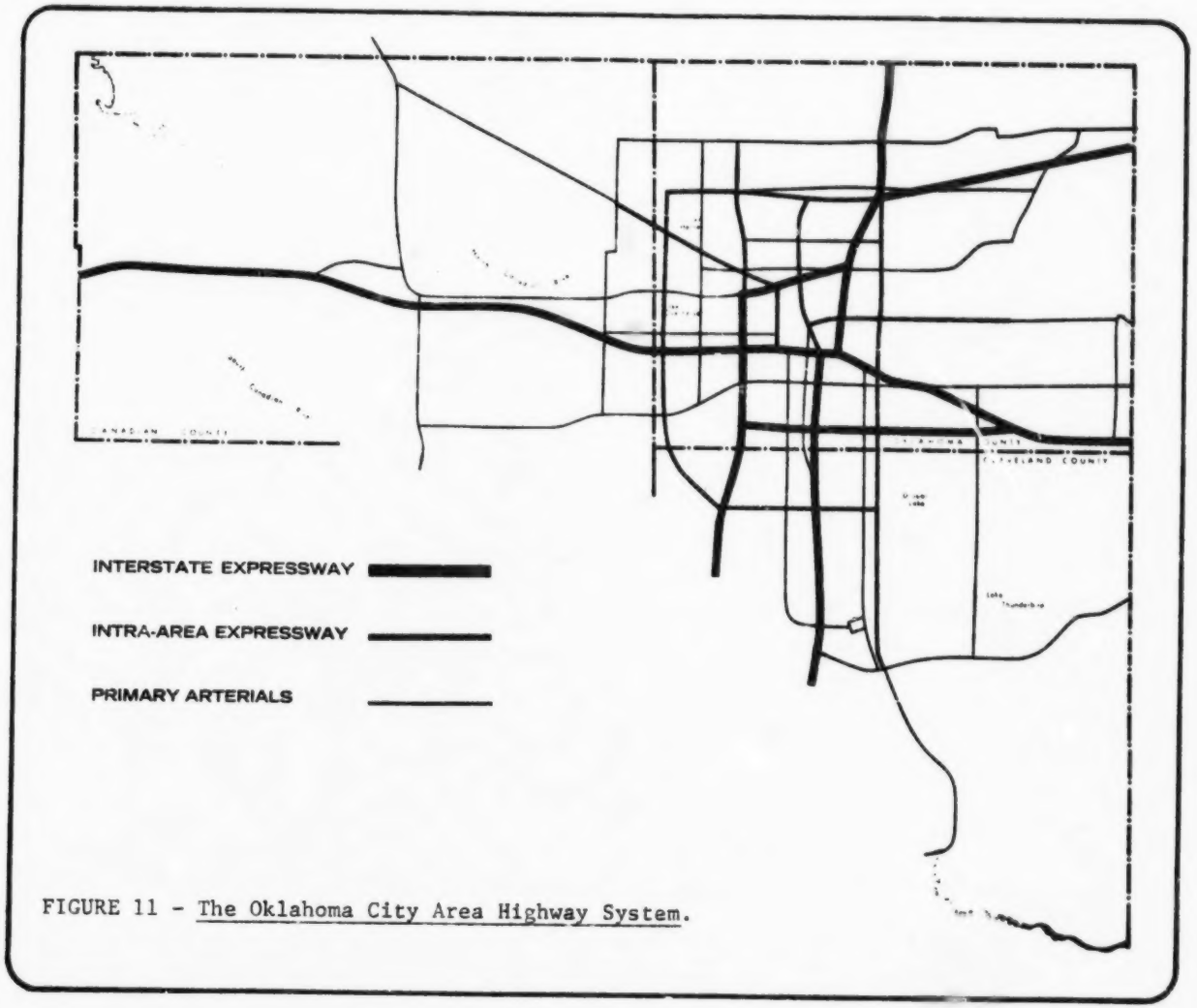

FIGURE 11 - The Oklahoma City Area Highway System.

of Canadian County, even with the existence of Interstate Highway 40 and its many access points, is also unlikely because of the distances involved. In addition to these existing major arteries, a cross-town north-south toll road is being planned by the Turnpike Authority. In summary, the most probable directions of urban growth are toward Guthrie in Logan County, Shawnee in Pottawatomie County, and Beyond Norman into McClain County.

EVALUATION OF TECHNICAL FACTORS

Technical factors of importance in determining the boundaries of an air quality control region are:

a) the total quantity of pollutants emitted,

b) the geographic pattern of emission sources,

c) topography and meteorology, and

d) patterns of pollutant dispersion.

In the Oklahoma City area, information with respect to these factors was obtained from an emission inventory conducted by the National Air Pollution Control Administration (NAPCA), consultation with Oklahoma State and local officials, review of existing air quality data and a theoretical diffusion model.

THE EMISSION INVENTORY

The emission inventory[6] was conducted in Oklahoma City based on the calendar year 1968. The study area included the three-county Oklahoma SMSA (Oklahoma, Canadian, and Cleveland Counties) plus six surrounding counties (Grady, Kingfisher, Lincoln, Logan, McClain, and Pottawatomie Counties). The total area encompasses 7,234 square miles and an estimated current population of 737,200. These nine counties include practically all of the significant pollution sources in the area.

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[6] Oklahoma City Metropolitan Area Air Pollutant Emission Inventory. U. S. Department of Health, Education, and Welfare, Public Health Service, NAPCA, Durham, North Carolina, February 1970.

The pollutants inventoried included sulfur oxides, particulates, carbon monoxide, hydrocarbons, and oxides of nitrogen. The quantities of pollutants emitted in the Oklahoma City area were estimated individually for major point sources and areawide for all other sources through a technique developed by the Public Health Service.[7] Point sources included liquid petroleum gas (LPG) plants, refuse dumps, industrial plants, and airports. Area sources included automobiles, space heating, and smaller industrial plants.

Emission estimates were derived by applying average emission factors[8] to indicators of pollutant emissions such as production data and type of fuel burned. Because these factors are averages, the estimates for a particular point source may vary from actual emission. Estimates for a large number of sources tend to approximate actual conditions since their total characteristics balance out in the aggregate. Point source estimates are combined with areawide estimates to arrive at total emission estimates in tons per year of each pollutant. These estimates are shown by county in Table VI and Figure 12. Road vehicles are the largest contributor to emissions. This is shown graphically in Figure 13 (and Figure 13 continued)

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[7] Public Health Service, Rapid Survey Technique for Estimating Community Air Pollution Emissions. Publication No. 999-AP-29, Environmental Health Series, U.S. DHEW, Division of Air Pollution, Cincinnati, Ohio, 1966.

[8] Public Health Service, Compilation of Air Pollutant Emission Factors. Publication No. 999-AP-42, Environmental Health Series, U. S. DHEW, NAPCA, Durham, North Carolina.

Table VI

Air Pollutant Emissions in the Oklahoma City Study Area, by Emissions Sources and by County, 1968
(tons per year)

		Fuel Combustion								
	County	Industrial	Institutional	Residential	Power Plants	Total, Fuel Combustion	Industrial Process Losses	Transportation	Refuse Disposal	Grand Total[a/]
Particulates	Canadian	N	N	20	---	20	1,620	200	110	1,950
	Cleveland	10	10	20	---	40	80	320	210	650
	Grady	N	N	20	---	20	1,100	140	220	1,480
	Kingfisher	N	N	N	---	N	780	70	110	960
	Lincoln	N	N	N	---	N	300	100	110	510
	Logan	N	N	N	---	N	30	90	80	200
	McClain	N	N	N	---	N	220	70	60	350
	Oklahoma	80	90	180	560	910	2,000	2,840	830	6,580
	Pottawatomie	N	N	10	---	10	910	210	350	1,490
Sulfur Oxides	Canadian	N	N	N	---	N	N	110	10	120
	Cleveland	N	N	N	---	N	N	170	10	180
	Grady	N	N	N	---	N	N	80	10	90
	Kingfisher	N	N	N	---	N	N	40	10	50
	Lincoln	N	N	N	---	N	N	50	10	60
	Logan	N	N	N	---	N	N	40	N	40
	McClain	N	N	10	---	10	N	30	N	40
	Oklahoma	N	N	10	10	20	N	1,420	90	1,530
	Pottawatomie	N	N	10	---	10	N	110	20	140
Carbon Monoxide	Canadian	N	N	N	---	N	N	17,270	580	17,900
	Cleveland	N	N	N	---	N	N	28,340	1,120	29,500
	Grady	N	N	N	---	N	N	11,680	1,160	12,800
	Kingfisher	N	N	N	---	N	N	6,710	600	7,310
	Lincoln	N	N	N	---	N	N	8,170	600	8,770
	Logan	N	N	N	---	N	N	7,590	450	8,040
	McClain	N	N	N	---	N	N	5,790	350	6,140
	Oklahoma	N	N	N	N	N	90	315,620	4,400	320,100
	Pottawatomie	N	N	N	---	N	N	17,530	1,880	19,400

Notes: "N", negligible; "a", totals have been rounded.

Source: National Air Pollution Control Administration Air Pollutant Emission Inventory.

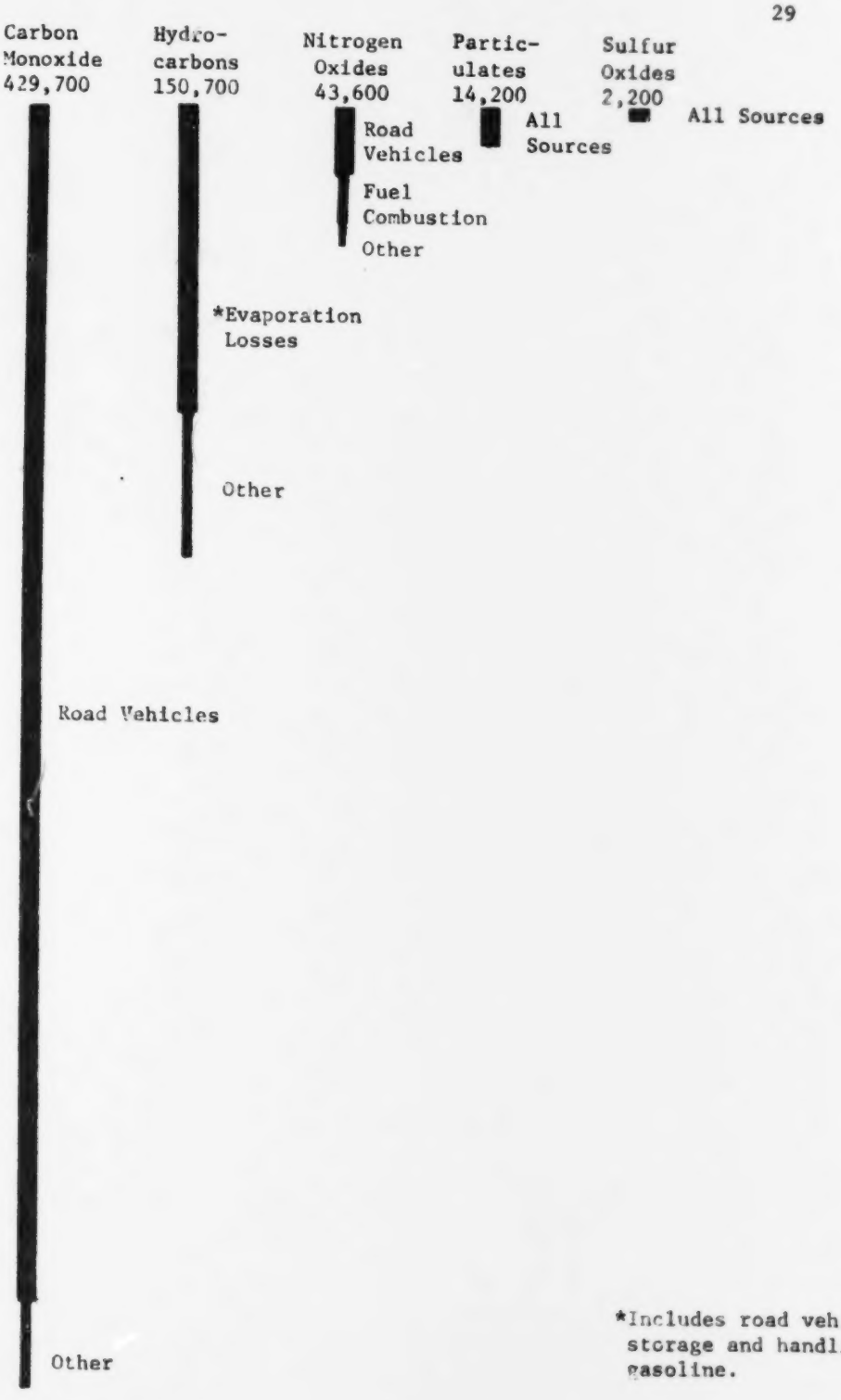

FIGURE 12 - Tons of Air Pollutant Emissions in the Oklahoma City Study Area During 1968

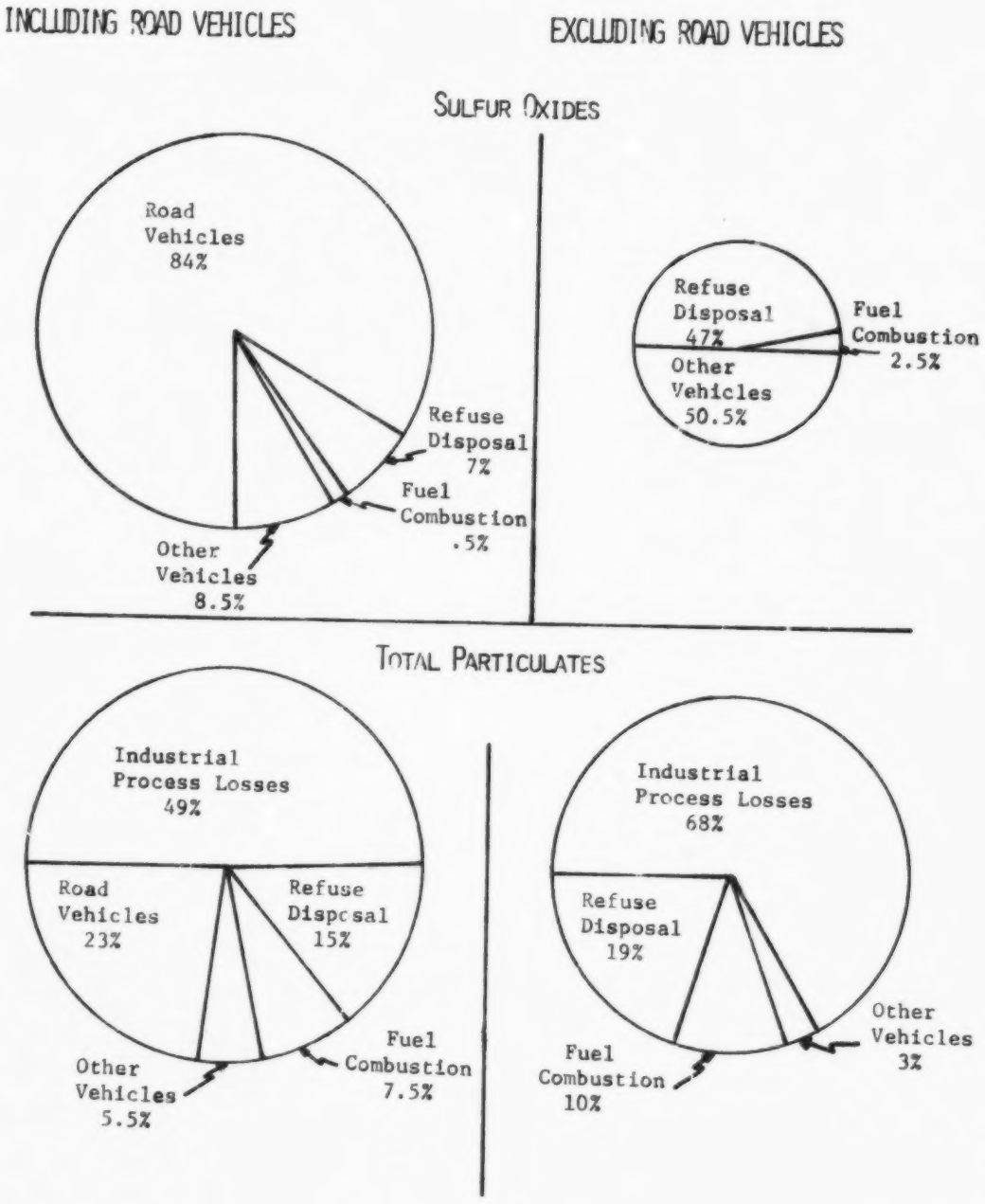

FIGURE 13 - Estimated Distribution of Emissions by Source, Inclusive and Exclusive of Road Vehicles, Oklahoma City Study Area, 1968

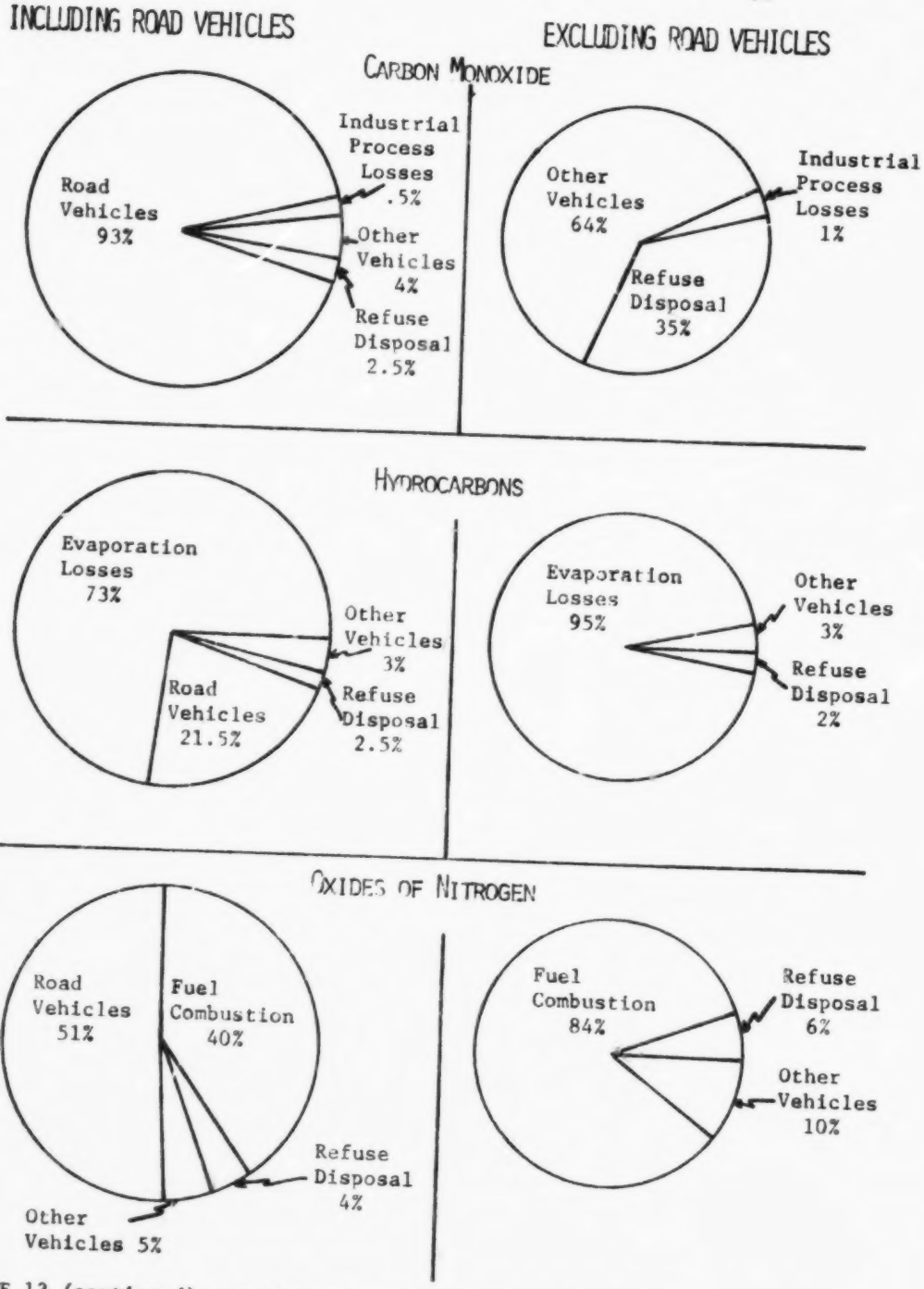

FIGURE 13 (continued) - Estimated Distribution of Emissions by Source, Inclusive and Exclusive of Road Vehicles, Oklahoma City Study Area, 1968

which presents pollutant emissions by source on a percentage basis, including and excluding road vehicles.

To determine the geographic distribution of emissions, the study area was divided into grid zones (Figure 14). The estimated point and area source emissions were attributed to their respective grid zones. Point source emissions by grid zones are shown in Table VII and geographically located on the grid zone map in Figure 15. Areawide pollutant estimates are shown in Table VIII. Density variations amorg the grid zones are shown in Figures 16 and 17. In interpreting these data, a discussion of sources in the study area is needed.

Oklahoma City relies primarily on natural gas as a fuel, and as a result, has a minimal areawide sulfur oxide problem. Of the very small total amount of sulfur oxide produced, 92 percent is generated by transportation (automobiles, 84 percent; aircraft and railroads, 8 percent). Refuse disposal operations account for practically all of the remaining 8 percent.

Particulate emissions in the study area arise primarily from the operations of fertilizer plants, grain elevators, rock processing plants, and transportation sources. Particulate emissions arising from fuel combustion amounts to less than 8 percent of the total; industry contributes 36 percent; transportation, 29 percent; and waste disposal, 15 percent.

Ninety-three percent of the carbon monoxide in the study area is generated by automobiles and other vehicles. Railroad

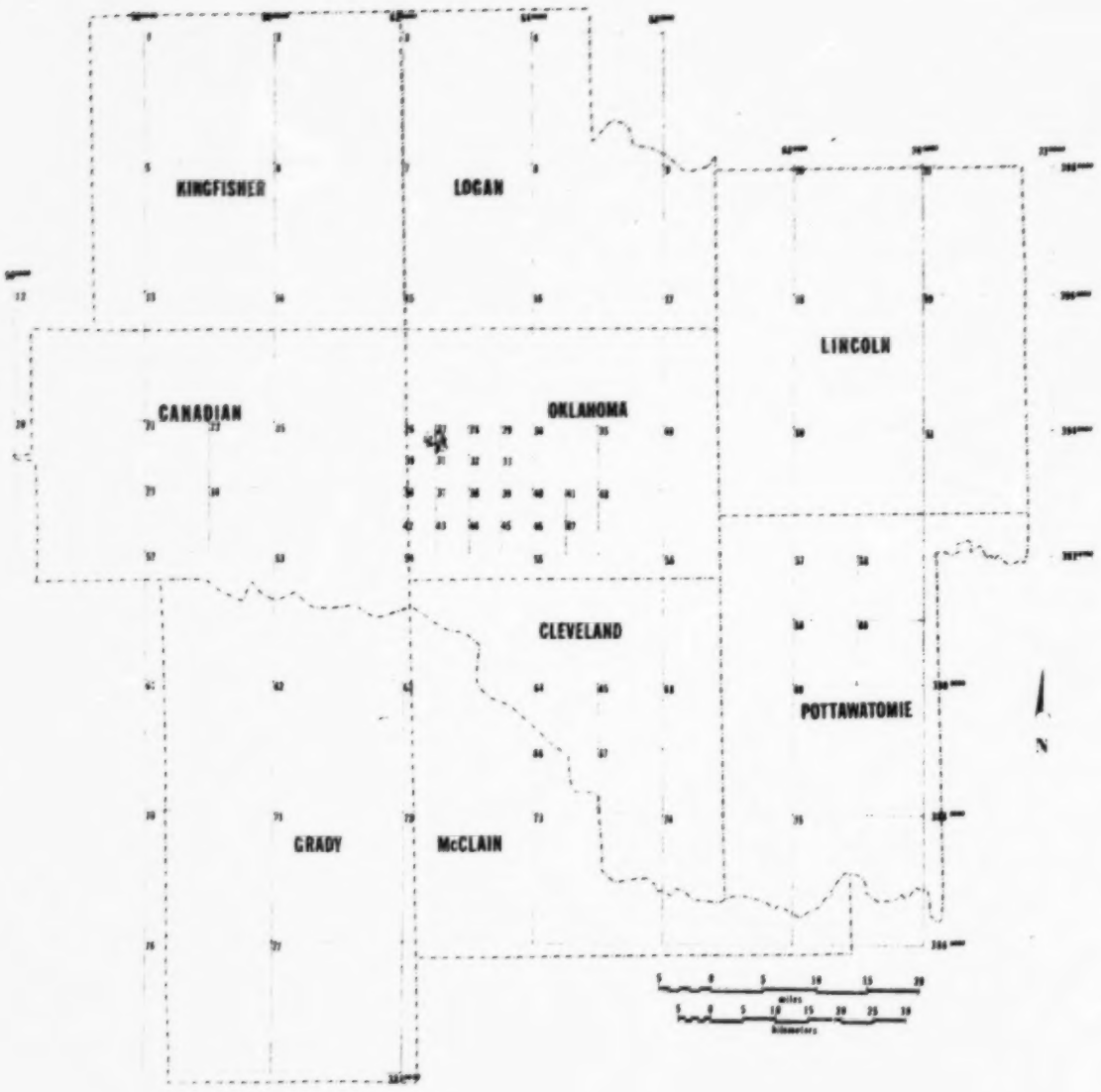

FIGURE 14 - Grid Coordinate System for the Oklahoma City Area

Table VII

Air Pollutant Emissions From Point Sources
in the Oklahoma City Area, 1968

(Annual Average Tons Per Day)

Source	Grid	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
LPG Plant	1	0.0	0.00	0.00	3.04	0.00
LPG Plant	1	0.0	0.00	0.00	13.90	0.00
Dump	1	0.0	0.14	0.76	0.26	0.09
Ind. Plant	5	0.0	0.56	0.00	0.00	0.00
Ind. Plant	5	0.0	0.84	0.00	0.00	0.00
Dump	5	0.0	0.11	0.61	0.21	0.07
Dump	8	0.0	0.16	0.87	0.30	0.11
LPG Plant	9	0.0	0.00	0.00	0.99	0.00
Ind. Plant	12	0.0	0.70	0.00	0.00	0.00
Ind. Plant	15	0.0	0.62	0.00	0.00	0.00
Dump	15	0.0	0.30	1.59	0.56	0.20
LPG Plant	15	0.0	0.00	0.00	15.60	0.00
Dump	18	0.0	0.15	0.82	0.29	0.10
LPG Plant	19	0.0	0.00	0.00	0.72	0.00
LPG Plant	19	0.0	0.00	0.00	2.67	0.00
Ind. Plant	19	0.0	0.55	0.00	0.00	0.00
Ind. Plant	22	0.0	0.80	0.00	0.00	0.00
Ind. Plant	22	0.0	0.70	0.00	0.00	0.00
Ind. Plant	25	0.0	1.04	0.00	0.00	0.00
Dump	25	0.0	0.19	1.05	0.37	0.13
Airport	25	0.0	0.02	5.69	1.12	0.26
LPG Plant	29	0.0	0.00	0.00	1.58	0.00
LPG Plant	29	0.0	0.00	0.00	1.58	0.00
Dump	29	0.0	0.37	1.97	0.69	0.25
Airport	30	0.0	0.12	13.21	2.54	0.65

Table VII (Continued)

Air Pollutant Emissions From Point Sources
in the Oklahoma City Area, 1968

(Annual Average Tons Per Day)

Source	Grid	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
Power Plant	32	0.0	0.01	0.00	0.00	0.50
Dump	33	0.0	0.51	2.75	0.97	0.35
Power Plant	36	0.0	0.67	0.00	0.00	17.52
Ind. Plant	38	0.0	0.82	0.00	0.00	0.00
Ind. Plant	39	0.0	1.71	0.00	0.00	0.00
Dump	43	0.0	0.12	0.68	0.24	0.08
Ind. Plant	44	0.0	0.82	0.00	0.00	0.00
LPG Plant	46	0.0	0.00	0.00	3.59	0.00
LPG Plant	49	0.0	0.82	0.00	0.00	21.54
Ind. Plant	52	0.0	0.69	0.00	0.00	0.00
LPG Plant	54	0.0	0.00	0.00	2.46	0.00
Airport	54	0.0	0.03	7.48	1.45	0.34
Airport	54	0.0	0.53	24.81	5.33	1.52
Ind. Plant	57	0.0	0.78	0.00	0.00	0.00
Ind. Plant	57	0.0	0.70	0.00	0.00	0.00
Dump	57	0.0	0.71	3.80	1.34	0.49
Ind. Plant	61	0.0	2.73	0.00	0.00	0.00
Dump	61	0.0	0.32	1.74	0.61	0.22
Airport	61	0.0	0.00	1.32	0.26	0.06
Dumps	64	0.0	0.54	2.87	1.01	0.37
LPG Plant	72	0.0	0.00	0.00	4.77	0.00
LPG Plant	72	0.0	0.00	0.00	1.07	0.00
LPG Plant	77	0.0	0.00	0.00	21.40	0.00

Source: National Air Pollution Control Administration Air Pollutant Emission Inventory.

Note: "LPG Plants" are liquid petroleum gas plants; "Ind. Plants" are industrial plants.

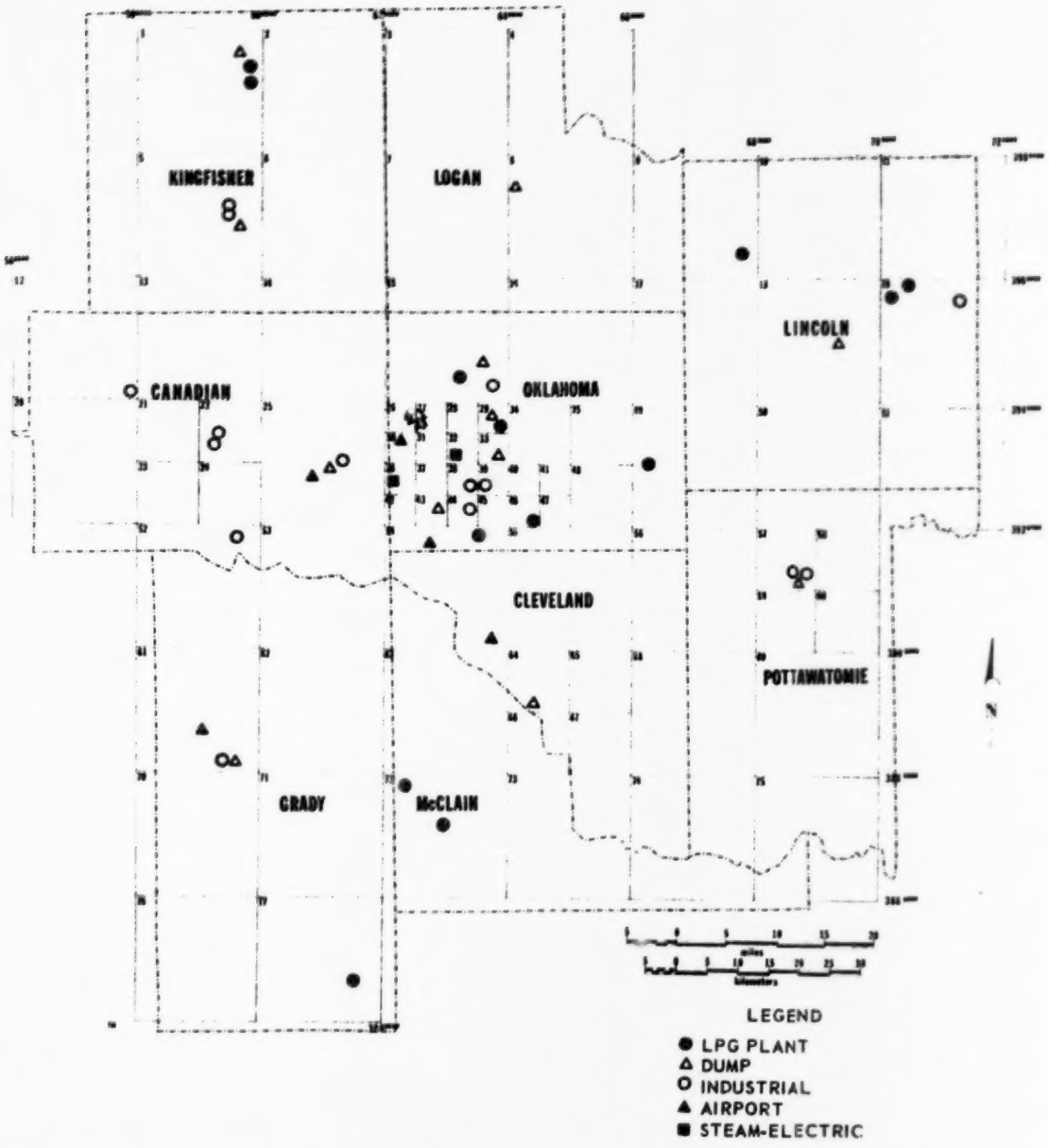

Figure 15. Point source locations for the Oklahoma City study area.

Table VIII

Air Pollutant Emissions From All Sources in the Oklahoma City Study Area, 1968

(Annual Average Tons Per Day)

Grid	Land Area (Sq. Mi.)	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
1	154.4	0.0	0.5	4.6	26.8	0.5
2	154.4	0.0	0.0	1.8	4.6	0.2
3	154.4	0.0	0.0	1.1	0.8	0.1
4	154.4	0.0	0.0	0.9	0.7	0.1
5	154.4	0.1	2.1	9.9	18.3	0.7
6	154.4	0.0	0.0	2.4	4.8	0.2
7	154.4	0.0	0.0	3.1	1.9	0.2
8	154.4	0.1	0.5	15.3	9.2	1.3
9	154.4	0.0	0.0	1.3	2.3	0.1
10	154.4	0.0	0.0	1.7	2.1	0.2
11	154.4	0.0	0.0	1.1	1.4	0.1
12	154.4	0.0	0.7	1.0	0.2	0.1
13	154.4	0.0	0.1	3.4	2.8	0.3
14	154.4	0.0	0.0	1.9	1.3	0.2
15	154.4	0.1	1.2	17.4	19.3	1.3
16	154.4	0.1	0.3	27.5	4.0	1.7
17	154.4	0.0	0.1	8.1	2.9	0.6
18	154.4	0.0	0.2	5.9	6.1	0.5
19	154.4	0.0	1.0	4.9	9.4	0.5
20	154.4	0.0	0.0	1.0	0.2	0.1
21	38.6	0.0	0.0	1.2	0.2	0.1
22	38.6	0.1	1.8	21.5	4.0	1.7
23	38.6	0.0	0.0	0.9	0.2	0.1
24	38.6	0.0	0.0	1.1	0.2	0.1
25	154.4	0.1	1.4	15.3	3.2	1.2

Table VIII (Continued)

Air Pollutant Emissions From All Sources
in the Oklahoma City Study Area, 1968

(Annual Average Tons Per Day)

Grid	Land Area (Sq. Mi.)	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
26	9.6	0.0	0.0	2.1	0.3	0.2
27	9.6	0.0	0.1	4.8	0.9	0.4
28	9.6	0.1	0.2	12.8	3.2	1.1
29	9.6	0.0	0.4	5.2	2.7	0.5
30	9.6	0.1	0.3	21.8	4.5	1.4
31	9.6	0.3	0.9	70.4	9.7	3.8
32	9.6	0.3	0.6	58.0	9.3	3.9
33	9.6	0.2	0.9	46.2	6.9	2.7
34	38.6	0.1	0.2	14.4	2.7	1.1
35	38.6	0.0	0.1	3.9	0.9	0.3
36	9.6	0.1	0.8	11.3	2.0	18.2
37	9.6	0.2	0.6	49.4	8.2	3.1
38	9.6	0.4	3.1	113.5	16.6	5.6
39	9.6	0.3	3.0	65.3	11.5	4.1
40	9.6	0.1	0.3	24.8	4.3	1.6
41	9.6	0.1	0.1	10.6	1.8	0.7
42	9.6	0.0	0.0	1.5	0.3	0.1
43	9.6	0.1	0.4	20.6	3.6	1.4
44	9.6	0.3	1.6	87.5	12.9	4.4
45	9.6	0.2	0.4	37.7	6.6	2.3
46	9.6	0.3	0.5	47.9	11.4	3.2
47	9.6	0.1	0.2	10.3	2.9	1.0
48	38.6	0.1	0.1	10.7	1.8	0.7
49	154.4	0.1	0.9	6.5	2.4	22.0
50	154.4	0.0	0.1	4.9	3.7	0.3
51	154.4	0.0	0.1	3.3	3.5	0.3

Table VIII (Continued)

Air Pollutant Emissions From All Sources
in the Oklahoma City Study Area, 1968

(Annual Average Tons Per Day)

Grid	Land Area (Sq. Mi.)	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
52	154.4	0.0	1.3	3.4	1.8	0.3
53	154.4	0.0	0.1	4.0	2.0	0.4
54	154.4	0.4	2.0	98.1	27.0	7.3
55	154.4	0.4	0.9	60.0	23.1	5.0
56	154.4	0.0	0.1	6.1	1.6	0.5
57	38.6	0.2	2.7	31.4	13.0	2.7
58	38.6	0.0	0.0	1.9	0.8	0.1
59	38.6	0.0	0.2	7.2	3.0	0.6
60	38.6	0.0	0.0	1.4	0.6	0.1
61	154.4	0.1	3.6	21.7	14.0	1.9
62	154.4	0.0	0.0	1.4	1.0	0.1
63	154.4	0.0	0.2	6.0	6.9	0.4
64	38.6	0.0	0.8	5.4	2.0	0.6
65	38.6	0.0	0.0	1.0	0.4	0.1
66	38.6	0.0	0.0	0.8	0.7	0.1
67	38.6	0.0	0.0	0.7	0.3	0.1
68	154.4	0.0	0.0	1.9	0.9	0.2
69	154.4	0.0	0.1	3.3	1.5	0.3
70	154.4	0.0	0.1	1.7	1.3	0.2
71	154.4	0.0	0.0	2.2	1.7	0.2
72	154.4	0.0	0.0	2.2	9.2	0.2
73	154.4	0.1	0.3	9.2	11.8	0.9
74	154.4	0.0	0.0	2.1	2.3	0.2
75	154.4	0.0	0.0	1.3	0.8	0.1
76	154.4	0.0	0.1	2.2	1.7	0.2
77	154.4	0.0	0.0	0.9	22.1	0.1

SOURCE: National Air Pollution Control Administration Air Pollutant Emission Inventory.

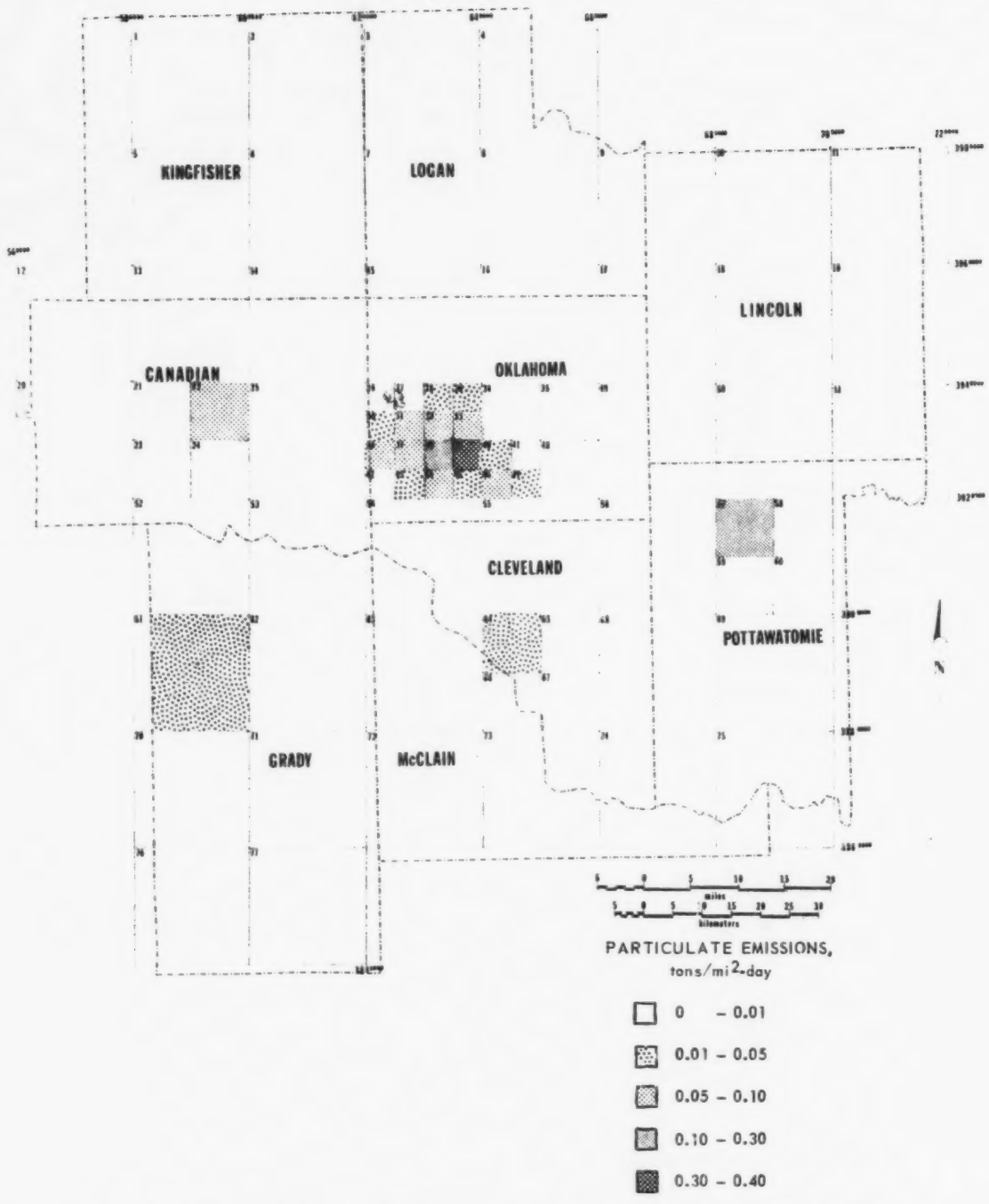

Figure 16. Particulate emissions densities for the Oklahoma City study area, 1968.

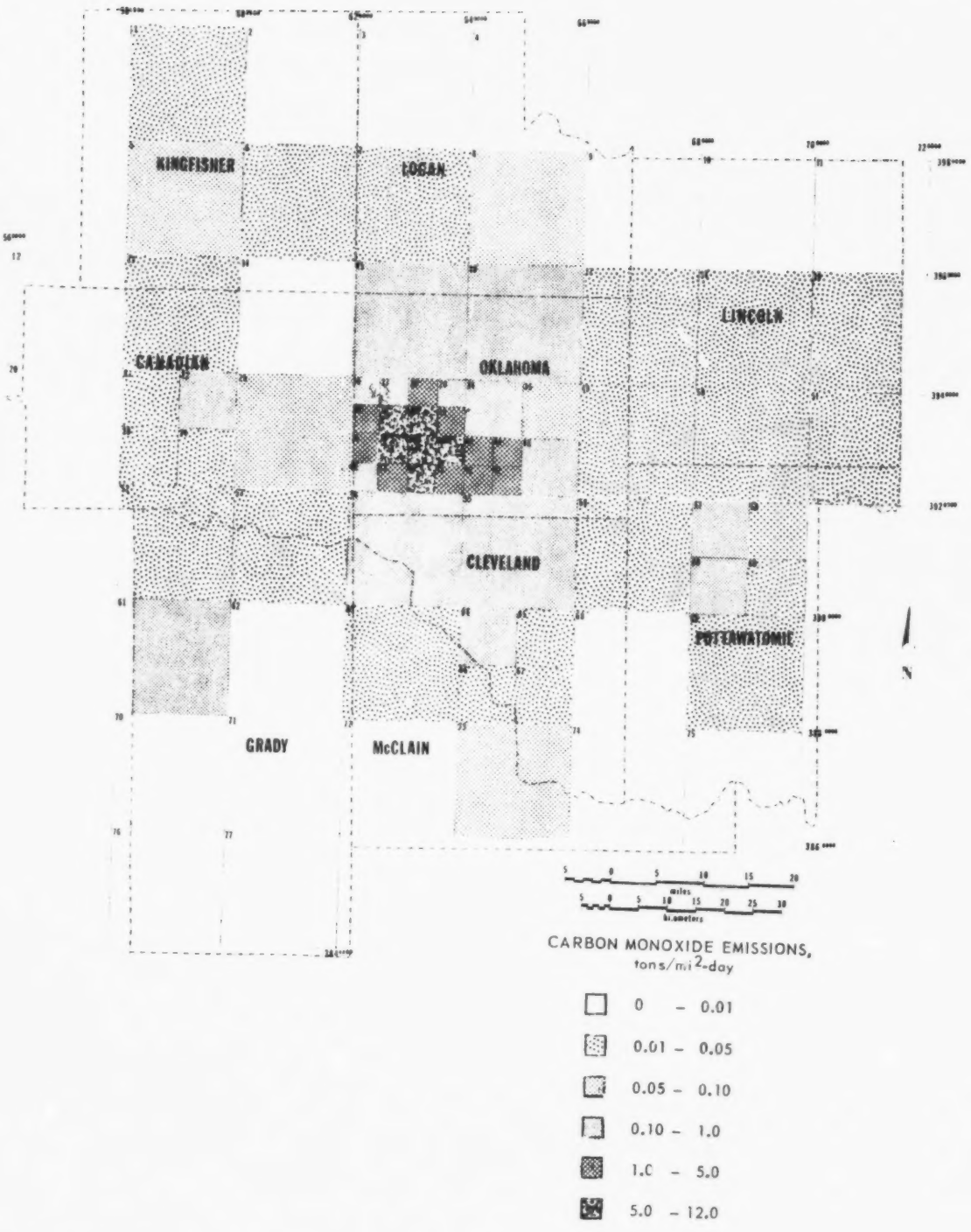

Figure 17. Carbon monoxide emission densities for the Oklahoma City study area, 1968.

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and aircraft operations contribute about 4 percent while the remainder comes from the burning of refuse.

Hydrocarbon emissions result from the operation of motor vehicles and evaporation. About 30 percent of hydrocarbon emissions are attributed to crude oil production, approximately 17 percent to gas processing plants, and about 32 percent from motor vehicles (including exhaust gases and evaporation losses). Nitrogen oxides are generated by motor vehicle exhausts (55 percent) and natural gas burning (41 percent). About a third of the nitrogen oxides from natural gas burning is emitted by the two steam power plants located in grid zones 32 and 36. A small quantity (4 percent) of NO_x comes from refuse burning.

The distribution and amount of pollutants in the Oklahoma City study area show marked differences from most regions previously studied. Sulfur oxide pollution does not appear to be as serious a problem as in most areas. Hydrocarbon emissions from fixed sources, on the other hand, are significant in the study area because of crude oil production and gas processing. Lack of effective incineration, use of private dumps and extensive open burning in the area make visible pollution from solid waste disposal a constant problem. Air pollution from electric power generation is less significant in the study area than in those regions where coal or residual oil is the principal fuel used in power plants.

AIR QUALITY ANALYSIS

The boundaries of an air quality control region should be inclusive of both pollution sources and people and property

affected by those sources. Sources and source areas have been identified by the emissions inventory. Further examination of air quality and other data is necessary to identify receptor areas prior to proposing Region boundaries.

The most accurate way to determine atmospheric distribution of contaminants is through the accumulation of reliable sampling data. Air sampling data gathered by the Oklahoma State Department of Health and the Oklahoma City-County Health Department have provided limited information.

A meteorological diffusion model has been used to compute pollutant dispersion patterns in the ambient air. This model is based on a mathematical treatment of pollutant emissions and meteorological factors such as wind speed and direction, and mixing depths. Although the model has inherent limitations, it is valuable in providing information on long-term relative pollutant concentrations.

Meteorology and Climatology

The climate of the study area is characteristic of the "continental climate" of the Great Plains region. It is untempered by large bodies of water or topography. Located at the southerly end of the Great Plains, the area has long and usually hot summers and short and mild winters. There are pronounced daily temperature changes and great variation in seasonal and annual rainfall. Prevailing winds are southerly and usually brisk, with occasional winter windstorms from the

north. The relatively shallow Canadian River valley and gently rolling topography offer very slight barriers to free movement of air through the area.

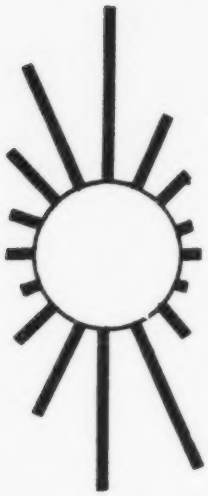
Wind speed and direction are significant influences on the dispersion of pollutants. Figure 18 displays the frequency of occurrence of wind from the various directions for the study area. Average wind speeds of 12 to 16 miles per hour help to keep the area well ventilated, although brisk winds sometimes cause "looping plumes" which may create localized and short-term air pollution fumigation problems.

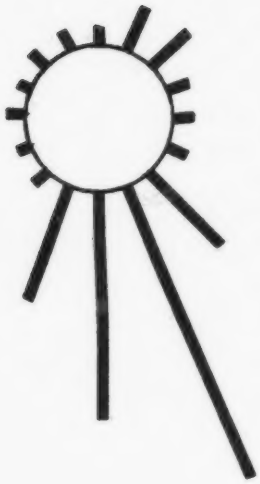
The percentage of sunshine is important as a determinant of photochemical smog. The study area experiences an average of 68 percent of possible sunshine (up to 75 percent in the summer months), which could contribute to the development of oxidant smog conditions when accompanied by low wind speeds.

Atmospheric inversions also affect the dispersion of pollutants. The study area exhibits a definite tendency toward local inversions which may persist for 24-30 hours 35-40% of the time. When these inversions are present, relatively large concentrations of pollutants can be expected, leading to visibility reductions. Table IX shows average mixing depths in meters for the area. These mixing depths provide a measure of the volume of air in which pollutants may disperse without obstruction.

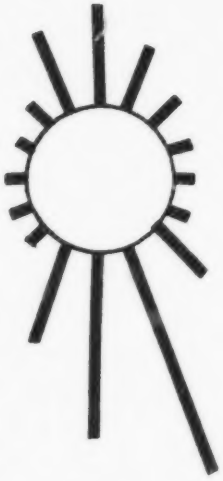
WINTER

SUMMER





ANNUAL
(Includes All Four Averaging Periods)



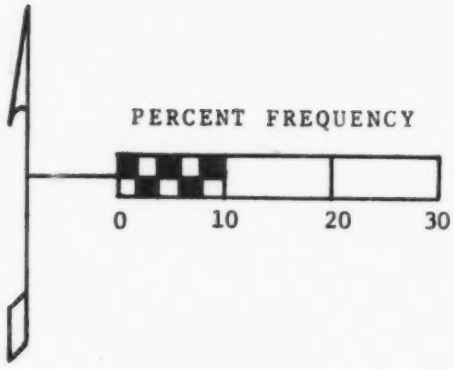


FIGURE 18 - Wind Direction Percent Frequency of Occurrence for Various Averaging Times

Table IX

Air Mixing Depths, Oklahoma City Area

(meters)

	Winter	Summer	Annual
MORNING	295	345	340
AFTERNOON	805	1830	1335
AVERAGE	550	1090	840

Source: National Air Pollution Control Administration Air Pollutant Emissions Inventory.

Modeling Results

Figure 19 shows the theoretical relative dispersion pattern for suspended particulates. Note that these dispersion patterns appear greatest around sources identified in the emission inventory. The centers of highest concentrations are located in downtown Oklahoma City, in a large portion of Oklahoma and Canadian Counties, and in outlying Grady, Kingfisher, and Pottawatomie Counties.

Air Sampling Data

A limited amount of air quality data has been collected in the area of concern by the State Department of Health and the Oklahoma City-County Health Department. Air sampling within the study area has taken place at 3 sites in Norman (Canadian County) and at six sites in Oklahoma City. The data acquired does not, however, assist in the identification of the geographic extent of the areawide air pollution problem centered on Oklahoma City.

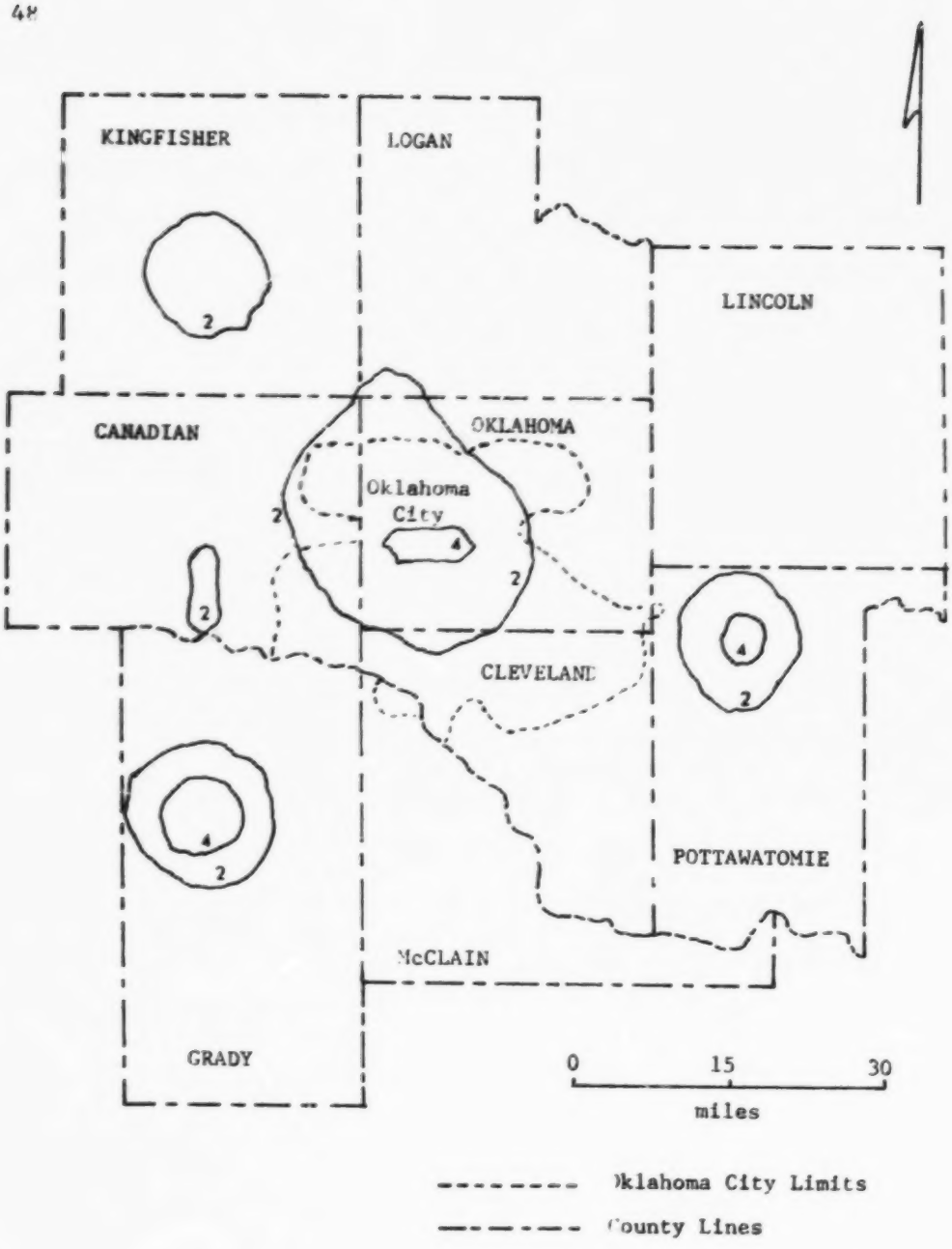


FIGURE 19 - Annual Average Theoretical Relative Concentration of Particulates, Oklahoma City Area

REGIONAL GOVERNMENTAL ORGANIZATION

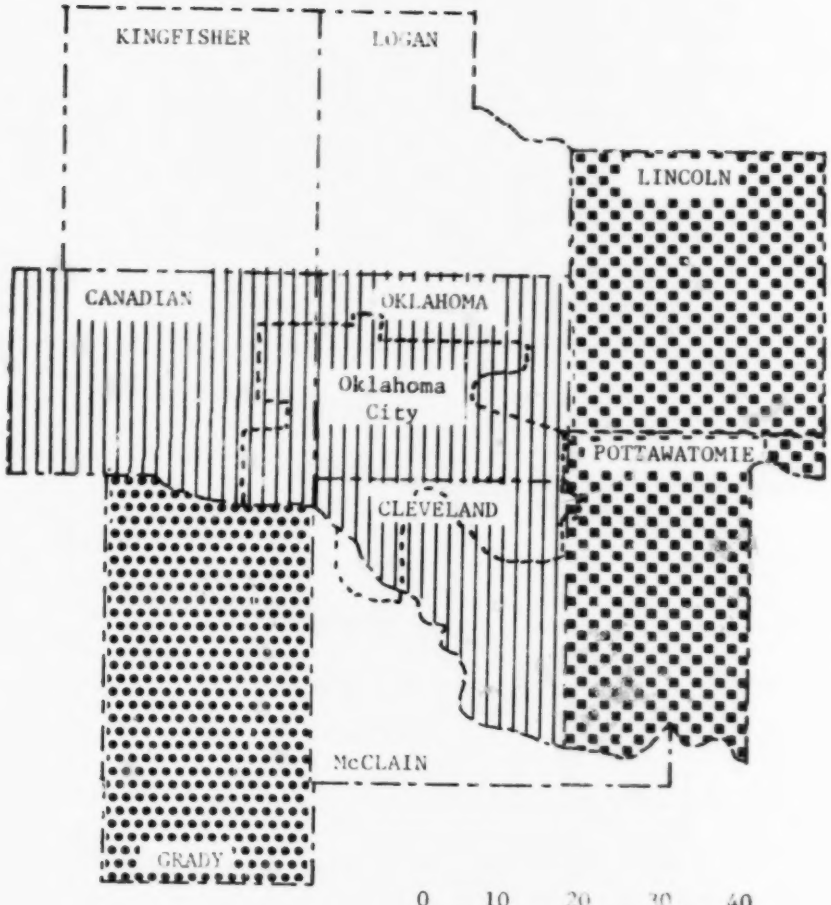
PLANNING ACTIVITIES

Introduction

Planning for air pollution control in the State of Oklahoma is vested in the State Department of Health. The Department is further authorized to control and abate air pollution. It is important, however, to consider planning activities in areas other than air pollution control since these may provide some indication of the nature of regional governmental cooperation which has taken place on the past or which currently exists. The designation of a region compatible with existing regional arrangements is desirable since the implementation of a regional air pollution control effort is dependent upon cooperation at the various levels of government. Further, region-wide planning programs may be capable of providing assistance in the development of air quality standards and a plan to implement those standards. The following sections discuss the geographic extent of regional planning commissions, councils of local governments, economic development districts and statistical data gathering bases in the Oklahoma City area. The boundaries over which these various functions are operative are shown in Figure 20.

Statistical Data Gathering Bases

The Oklahoma City Standard Metropolitan Statistical Area (SMSA) encompasses Canadian, Cleveland, and Oklahoma Counties.



Standard Metropolitan Statistical Area, Association of Central Oklahoma Governments (ACOG)

Part of Central Oklahoma Economic Development District

Part of South Central Economic Development District

FIGURE 20 - Counties in Oklahoma City Study Area Which Participate in Various Planning Agencies

By definition, an SMSA includes adjacent counties found to be metropolitan in character which are economically and socially integrated with the county of the central city. Objective criteria of a quantitative character were used to determine the existence of multi-jurisdictional interdependency among these three counties.

The Association of Central Oklahoma Governments (ACOG), a voluntary non-profit organization, was incorporated in 1966 under the authority of the State Interlocal Cooperation Act. Membership consists of the three counties within the SMSA and eighteen municipalities. ACOG is the areawide review agency for Federal grant applications and conducts planning studies for the three-county region. ACOG further provides a forum for identifying intergovernmental issues and formulating policies and plans to resolve them.

The ACOG work program includes water and sewer, parks, housing, and solid waste disposal. It provides public information services and agency and organization development assistance. ACOG has recently assumed responsibility for continuation of planning for transportation, originally carried out by the Oklahoma City Area Regional Transportation Study (OCARTS).

The 1970 Census may require a substantial change in the ACOG area. Planning estimates by ACOG lead the agency to believe that the SMSA may be expanded by the addition of McClain,

Logan, and/or Pottawatomie Counties. As the Federal grant application review agency, ACOG will then be responsible for plans review in the expanded SMSA, which may lead to expanded membership. Even now, McClain County has been linked with ACOG for law enforcement planning purposes.

Economic Development Districts

The Central Oklahoma Economic Development District (COEDD) agency, based in Shawnee, carries out the Federal grant review function for Pottawatomie County, and has produced elements of a master plan which includes Shawnee and Pottawatomie County.

The South Central Economic Development District (SCEDD), in Duncan, has begun to develop regional plans. The SCEDD includes Grady County to the south of Canadian County.

City Planning Department

Oklahoma City has a city planning department which has prepared land use and development plans for the city proper. Under an aggressive annexation policy, the City has continuously expanded its boundaries and today occupies most of Oklahoma County and extends into Cleveland, Canadian, McClain, and Pottawatomie Counties. A number of incorporated municipalities are now surrounded by Oklahoma City, and certain municipal services are supplied by contract with some of them. There are a total of seventeen incorporated municipalities in Oklahoma County.

Future Regional Considerations

In addition to the possible expansion of the SMSA as a result of the 1970 Census, another development may be expected to influence regional planning in the area. The Oklahoma Legislature recently enacted a new law authorizing the Oklahoma Industrial Development and Park Commission to develop criteria for the delineation of boundaries for planning regions and, after public hearings, adopt boundaries for regional planning agencies. It is expected that this new law will have a profound impact on all regional planning agencies within the State and may provide a useful tool for resolving conflicts between planning agencies in areas of overlapping responsibility.

AIR POLLUTION CONTROL ACTIVITIES

The State Legislature enacted the Oklahoma Clean Air Act in 1967 after several years of discussion. The law vests authority in the State Department of Health, with an Air Pollution Council appointed by the Governor and provides for a Director of Air Pollution employed by the Department of Health. The Board of Health is authorized to adopt statewide regulations after review by the Department of Health and after hearings conducted by the Air Pollution Council.

The Board has adopted two regulations: (1) on open burning and (2) on disabling of auto emission control devices. Four additional regulations are being developed which will cover (3) definitions as applied in the air pollution regulations, (4) registration of stationary emission sources, (5) incinerators

and fuel-burning equipment, and (6) visible emissions and particulate matter emitted to the outdoor atmosphere.

The State air pollution program has a current budget of $113,514, of which %52,112 is the Federal share. Four professional positions are presently filled and three additional positions are budgeted.

Other than the State program, the only air pollution control programs in the area are operated under traditional nuisance ordinances. Oklahoma City, for example, requires a fire department permit for open burning and prohibits the "injurious, offensive, or noxious" emission of smoke and dust into the air. Only two jurisdictions in the State have adopted ordinances under the 1967 State law--Tulsa, not in the study area, and Del City, in Oklahoma County, which has adopted an open burning ordinance.

The Oklahoma City Council is considering the adoption of an ordinance, and the State Board of Health is endeavoring to obtain uniform enactments throughout the study region. Oklahoma City received a Federal grant for the development of an air pollution control program, but the grant was not renewed. After passage of a satisfactory ordinance, the City expects to apply for an additional grant.

Regional Solid Waste Disposal

One of the most visible air pollution problems in the region is the emission of smoke and odor from burning dumps.

The Oklahoma State Health Department is the leading force in solid waste planning throughout the State. ACOG is cooperating with the State Health Department in the development of a regional solid waste disposal plan which will attempt to eliminate burning dumps.

PROPOSED AIR QUALITY CONTROL REGION

Subject to the scheduled consultation, the Secretary, Department of Health, Education, and Welfare, proposes to designate an air quality control region in the Oklahoma City area. The proposed region consists of the following counties in the State of Oklahoma (Figure 21):

Canadian
Cleveland
Logan
McClain
Oklahoma
Pottawatomie

Discussion

An air quality control region should meet three basic conditions:

1. It should encompass most significant air pollution sources as well as the receptors affected by the sources.

2. It should include those areas where industrial and residential growth may contribute to significant future air pollution problems.

3. It should be consistent with unified and cooperative administration of the region's air resources.

The data set forth in the Evaluation of Urban and Technical Factors indicates that the six-county area named above would satisfy the three conditions. While air pollutant source-emissions are most dense within Oklahoma County, major point sources and area sources exist throughout the remaining counties named in this proposal. Recognition of the fact that Canadian, Cleveland, Logan, McClain, and Pottawatomie Counties are likely

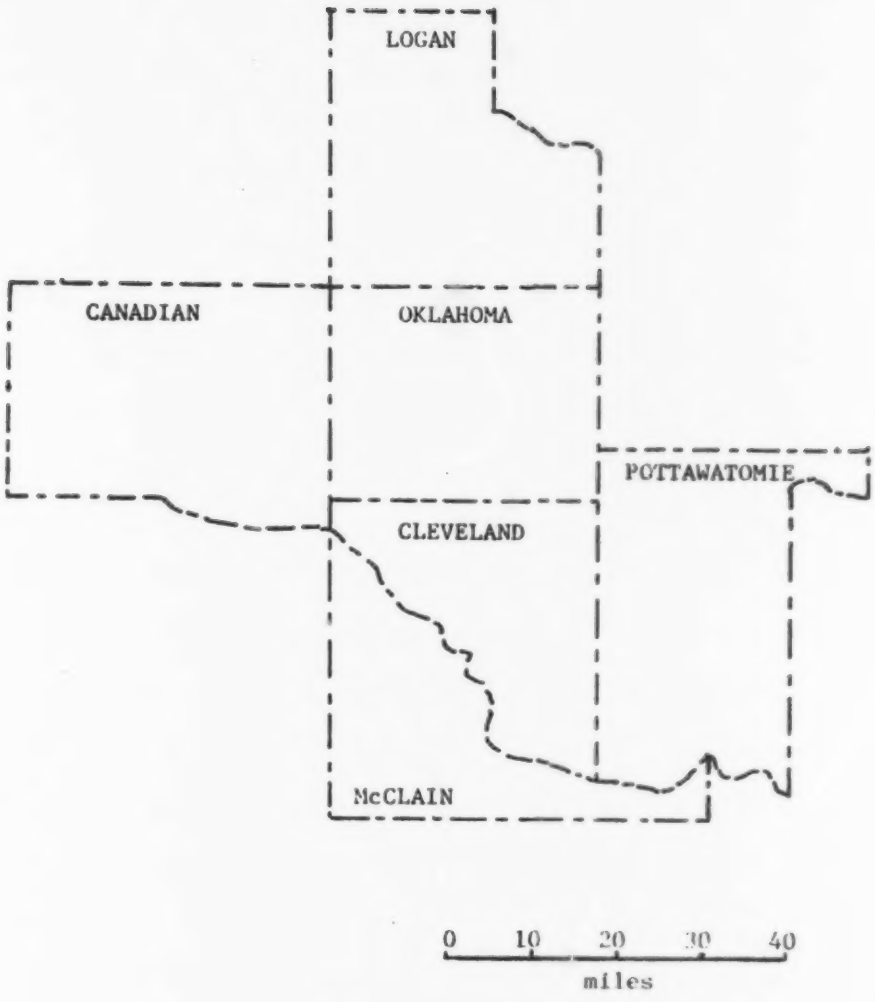


FIGURE 21 - Proposed Air Quality Control Region

to serve as receptor areas for air pollutants emitted not only from within their own boundaries, but also for air pollutants from the Oklahoma City urban core, makes their inclusion in the Region desirable.

The three-county Oklahoma SMSA would appear to be the minimum area over which regional air pollution control efforts should be conducted, based on a review of non-technical factors. There are in addition, however, present economic ties between residential centers in Logan, McClain, and Pottawatomie Counties and Oklahoma City; these ties are expected to undergo future strengthening either through increases in residential development or industrial plant location as the area shifts its activity toward more manufacturing.

Similar economic integration of Lincoln, Kingfisher, and Grady Counties to the urban Oklahoma City core does not appear as strong as that which exists between Logan, McClair, and Pottawatomie Counties and Oklahoma City. Significant future development from Oklahoma City to Lincoln, Kingfisher, and Grady Counties does not appear likely.

Although the recommended Region does not coincide with the present ACOG planning region boundaries, the likelihood that the planning region will expand following the 1970 Census exists. Since the probable need for an expansion of the SMSA and planning region boundaries is evident, the six counties represent a realistic Region proposal. The recommended six counties have the further advantage of including all the incorporated areas of Oklahoma City.

Because of the nature of the problem of air pollution, there is always the possibility that pollutant transport into or out of an established region may exist. An air quality control region can never be completely self-contained with respect to sources and receptors of air pollution. Thus, it would not be inappropriate to re-evaluate the six-county proposal in terms of selecting a larger area if this course of action appears warranted. Certainly, the existence of significant air pollutant sources in Grady, Kingfisher, and Lincoln Counties should not be disregarded if there is the possibility of endangerment to the public health and welfare.

In summary, the designation of the six-county Region should serve to encourage the effective use of State and local resource toward the solution of the areawide air pollution problem in Oklahoma City. The official designation of the Region will follow the Consultation with appropriate State and local authorities and after due consideration of all comments directed toward the six-county proposal.